

# MICROPROCESSORS AND MICROCONTROLLERS

## MODULE-1 OVERVIEW OF MICROPROCESSORS

# MODULE-1

## Overview of Microprocessors

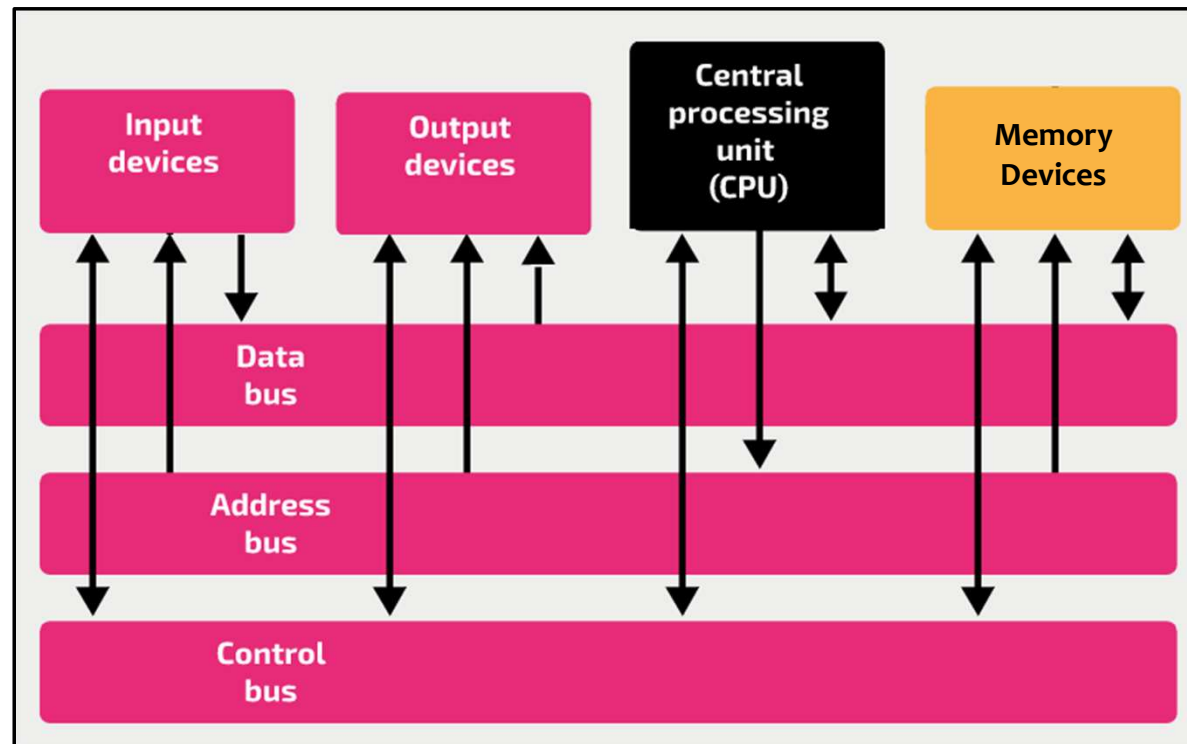
- Introduction to Microprocessors
- 8-bit /16-bit Microprocessor
- Overview of Intel Pentium, I (i3, i5, i7) Series Processor.

# INTRODUCTION TO MICROPROCESSOR

# INTRODUCTION TO MICROPROCESSOR

## COMPUTING SYSTEM

- Basic computing system consist of a Central processing unit (CPU)/ Microprocessor ( $\mu P$ ), memory (RAM, ROM), input/output (I/O) unit and System Buses(data, address, control)



**MICROPROCESSOR BASED COMPUTING SYSTEM**

<https://www.pcepuia.org/wp-content/uploads/2020/03/EE-6TH-SEM-UNIT-8-intel-8086.pdf>

# INTRODUCTION TO MICROPROCESSOR

## MICROPROCESSOR

- Microprocessor is a **Programmable, Clock driven, Register based, Electronic device** that communicates with the other devices using system bus to read instructions from a storage device, takes the data from input unit and processes the data according to the instructions and provides the result to the output unit.
  - **Programmable-** Perform different set of operations on the digital data depending on the sequence of instructions supplied by the programmer.
  - **Clock Driven** – Whole task is divided into basic operations, which are divided into precise system clock periods.
  - **Register Based** – Uses temporary storage elements while processing instructions
  - **Electronic Device** – fabricated on a single chip

# INTRODUCTION TO MICROPROCESSOR

## How does a Microprocessor Work?

- The microprocessor follows a sequence: **Fetch, Decode, and then Execute.**
- Initially, the instructions are stored in the memory in a sequential order.
- The microprocessor fetches those instructions from the memory, then decodes it and executes those instructions till STOP instruction is reached.
- Later, it sends the result in binary to the output port. Between these processes, the register stores the temporarily data and ALU performs the computing functions.
- CPU must equipped with necessary resource. Important resources of CPU:
  - **Registers** – to store the information temporarily
  - **ALU** – to carryout Arithmetic and Logical operation
  - **Program Counter** – to point the next instruction to be executed
  - **Instruction decoder** – to interpret the instruction fetched into the CPU

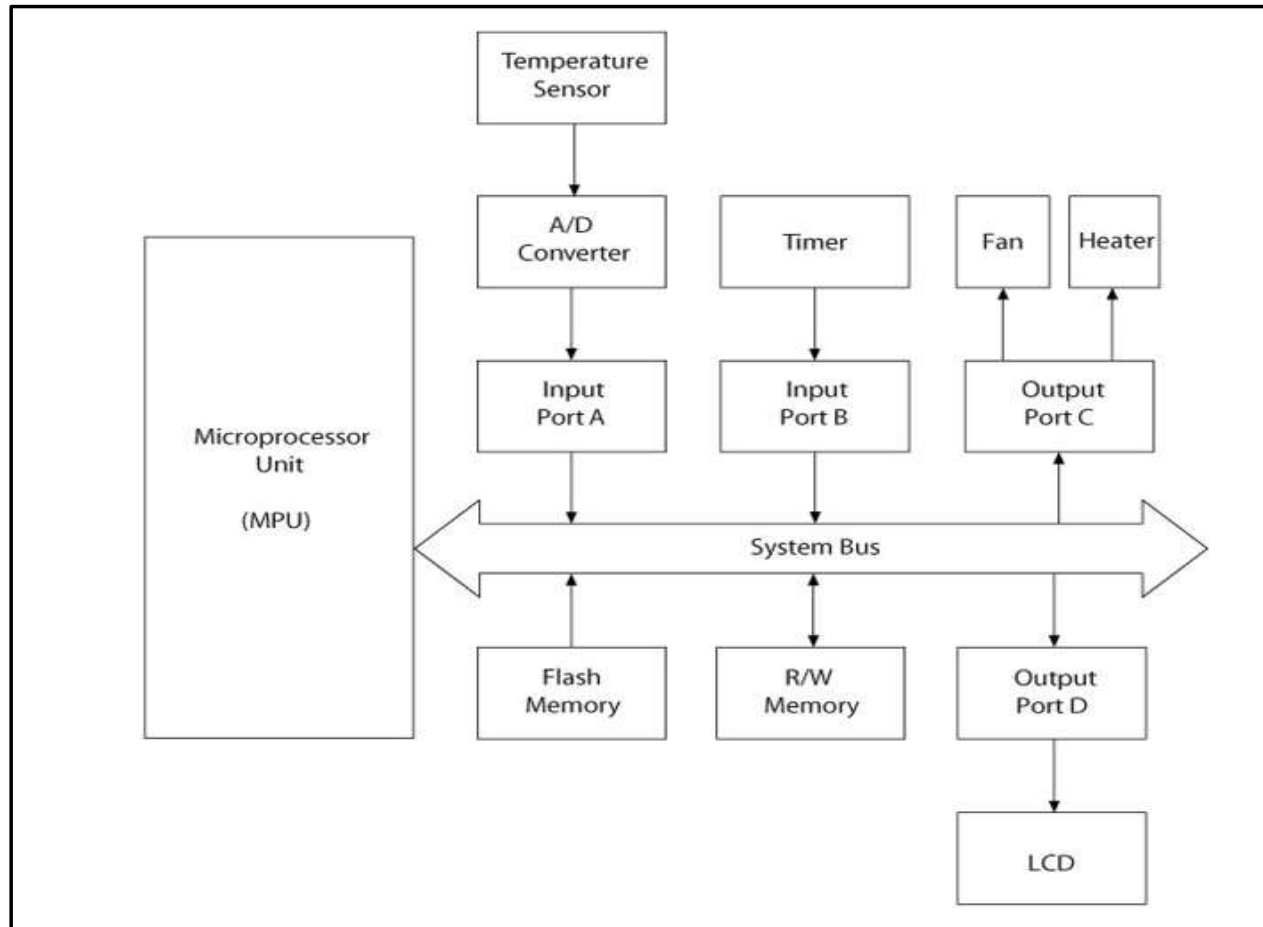
# INTRODUCTION TO MICROPROCESSOR

## MICROPROCESSOR – IMPORTANT TERMS

- **Instruction Set** — It is the set of instructions that the microprocessor can understand.
- **Bandwidth/Data size** — It is the number of bits processed in a single instruction.
- **Clock Speed** — It determines the number of operations per second the processor can perform. It is expressed in megahertz (MHz) or gigahertz (GHz). It is also known as Clock Rate.
- **Word Length** — It depends upon the width of internal data bus, registers, ALU, etc. An 8-bit microprocessor can process 8-bit data at a time. The word length ranges from 4 bits to 64 bits depending upon the type of the microcomputer.
- **Data Types** — The microprocessor has multiple data type formats like binary, BCD, ASCII, signed and unsigned numbers.

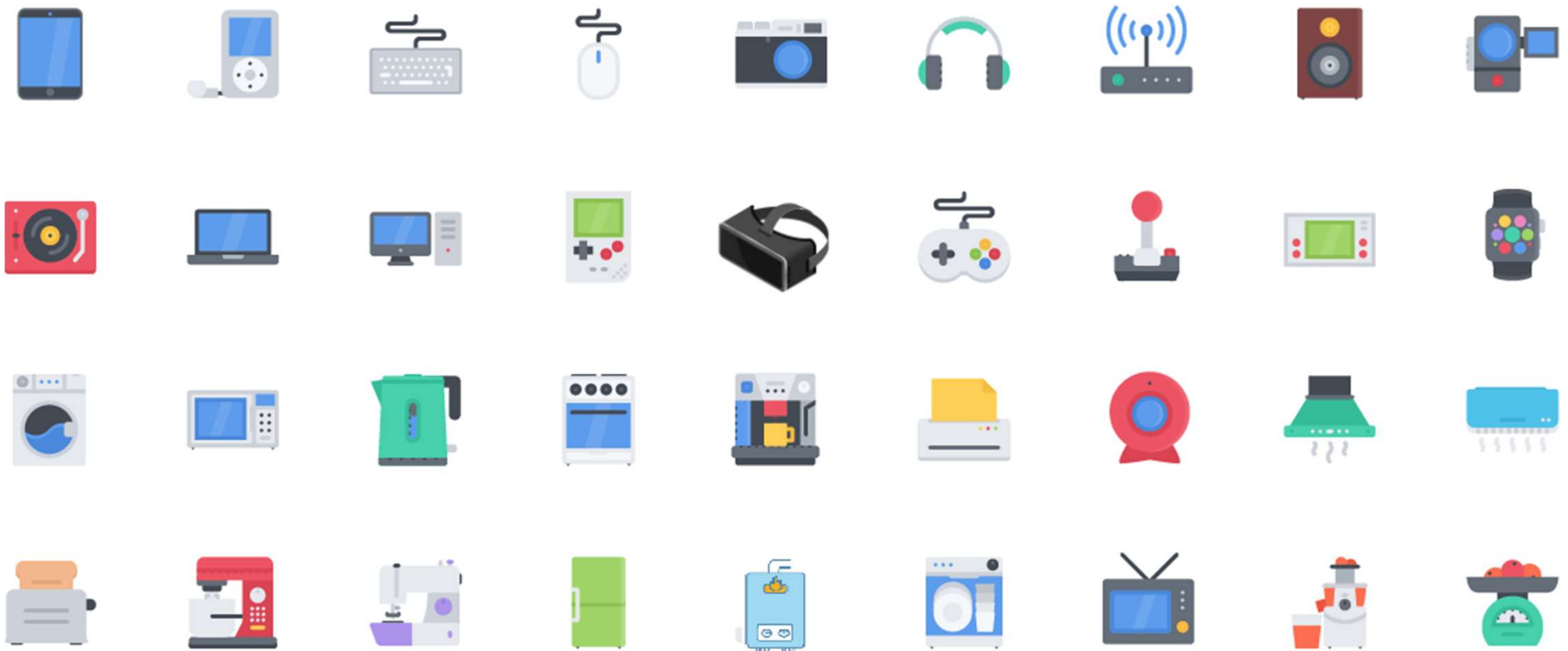
# INTRODUCTION TO MICROPROCESSOR

## MICROPROCESSOR BASED TEMPERATURE MONITORING SYSTEM



# INTRODUCTION TO MICROPROCESSOR

## APPLICATIONS OF MICROPROCESSOR



# EVOLUTION OF MICROPROCESSORS

# EVOLUTION OF MICROPROCESSORS

## WORLD'S FIRST MICROPROCESSOR - INTEL 4004

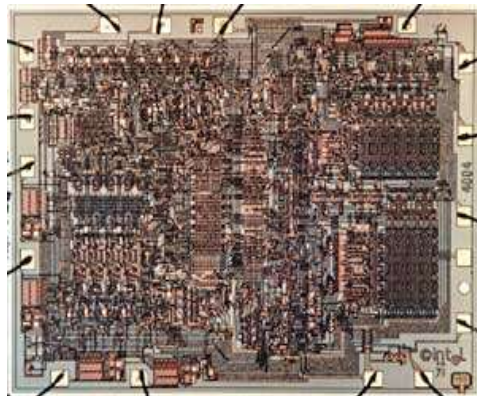
- **1969 - The assignment:** Nippon Calculating Machine Corporation approached Intel to design 12 custom chips for its new Busicom 141-PF\* printing calculator.
- **The Intel solution:** Intel designed a set of four chips known as the MCS-4.
  - ROM(4001) - To support the custom applications programs
  - RAM(4002) - For processing data
  - Shift registers(4003) - For the input/output (I/O) port
  - CPU(4004) - Central Processing Unit
- **1971- Era of integrated electronics:** Intel purchased the rights from Nippon Calculating Machine Corporation and launched the Intel 4004 processor and its chipset in the November 15, 1971.

# EVOLUTION OF MICROPROCESSORS

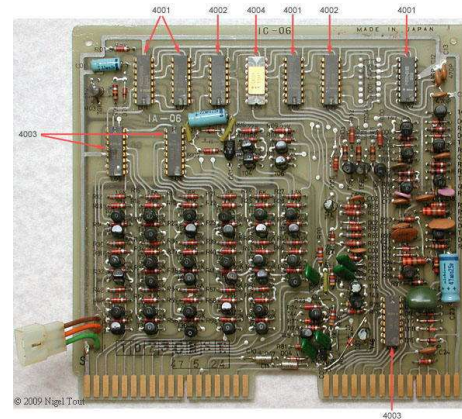
## WORLD'S FIRST MICROPROCESSOR - INTEL 4004



INTEL 4004 IC



DIE VIEW OF INTEL 4004 IC



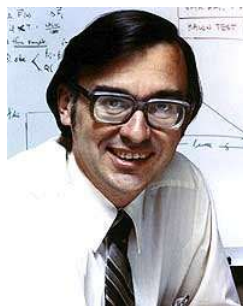
INTERNAL VIEW OF BUSICOM 141-PF



BUSICOM 141-PF PRINTING CALCULATOR



FEDERICO FAGGIN



MARCIAN "TED" HOFF



STANLEY MAZOR



MASATOSHI SHIMA

INVENTERS OF INTEL 4004 MICROPROCESSOR

# EVOLUTION OF MICROPROCESSORS

## WORLD'S FIRST MICROPROCESSOR - INTEL 4004

- We can categorize the microprocessor according to the generations or according to the size of the microprocessor:
- **First Generation (4 - bit Microprocessors):**
  - The first generation microprocessors were introduced in the year 1971-1972 by Intel Corporation. It was named Intel 4004 since it was a 4-bit processor.
  - It was a processor on a single chip. It could perform simple arithmetic and logical operations such as addition, subtraction, Boolean OR and Boolean AND.
- **Second Generation (8 - bit Microprocessor):**
  - The second generation microprocessors were introduced in 1973 again by Intel.
  - It was a first 8 - bit microprocessor which could perform arithmetic and logic operations on 8-bit words. It was Intel 8008, and another improved version was Intel 8088.

# EVOLUTION OF MICROPROCESSORS

## WORLD'S FIRST MICROPROCESSOR - INTEL 4004

- **Third Generation (16 - bit Microprocessor):**
  - The third generation microprocessors, introduced in 1978 were represented by Intel's 8086, Zilog Z800 and 80286, which were 16 - bit processors with a performance like minicomputers.
- **Fourth Generation (32 - bit Microprocessors):**
  - Several different companies introduced the 32-bit microprocessors, but the most popular one is the Intel 80386.
- **Fifth Generation (64 - bit Microprocessors):**
  - After 80856, Intel came out with a new processor namely Pentium processor followed by Pentium Pro CPU, which allows multiple CPUs in a single system to achieve multiprocessing.
  - Other improved 64-bit processors are Celeron, Dual, Quad, Octa Core processors.

# EVOLUTION OF MICROPROCESSORS

## EVOLUTION OF INTEL PROCESSORS (1)

| Processor         | Year of release | Clock Rate         | Fabrication Technology |
|-------------------|-----------------|--------------------|------------------------|
| 4004              | Nov. 15,1971    | 108 kHz            | 10-micron              |
| 8008              | April 1972      | 200 kHz            | 10-micron              |
| 8080              | April 1974      | 2 MHz              | 6-micron               |
| 8085              | March 1976      | 2 MHz              | 3-micron               |
| 8086              | June 8, 1978    | 10 MHz, 8 MHz      | 3-micron               |
| 8088              | June 1979       | 8 MHz, 4.77 MHz    | 3-micron               |
| 80286             | Feb. 1982       | 12 MHz, 10 MHz     | 1.5-micron             |
| i80386            | 1985 - 1990     | 33 MHz, 16 MHz     | 1 - 1.5-micron         |
| i80486            | 1989 - 1992     | 25 MHz - 100 MHz   | 1 - 0.6-micron         |
| Intel Pentium I   | 1993 - 1999     | 65 MHz - 250 MHz   | 800 nm - 350 nm        |
| Intel Pentium MMX | 1996 - 1999     | 120 MHz - 300 MHz  | 350 nm - 250 nm        |
| Intel Atom        | 2008-present    | 800 MHz - 2.13 GHz | 32 nm, 45 nm           |
| Intel Celeron     | 1998-present    | 266 MHz - 3.6 GHz  | 14 nm to 250 nm        |
| Intel Pentium Pro | 1995 - 1998     | 150 MHz - 200 MHz  | 350 nm, 500 nm         |
| Intel Pentium II  | 1997 - 1999     | 233 MHz - 450 MHz  | 250 nm, 350 nm         |

# EVOLUTION OF MICROPROCESSORS

## EVOLUTION OF INTEL PROCESSORS (2)

| Processor               | Year of release | Clock Rate          | Fabrication Technology            |
|-------------------------|-----------------|---------------------|-----------------------------------|
| Intel Pentium III       | 1999 - 2003     | 450 MHz - 1.4 GHz   | 130 nm, 180 nm, 250 nm            |
| Intel Xeon              | 1998-present    | 400 MHz - 4.4 GHz   | 45 nm to 250 nm                   |
| Pentium 4               | 2000 - 2008     | 1.3 GHz - 3.8 GHz   | 65 nm, 90 nm, 130 nm, 180 nm      |
| Pentium 4               | 2000 - 2008     | 3.2 GHz - 3.73 GHz  | 90 nm, 130 nm                     |
| Pentium M               | 2003 - 2008     | 800 MHz - 2.266 GHz | 90 nm, 130 nm                     |
| Pentium D/EE            | 2005 - 2008     | 2.66 GHz - 3.73 GHz | 65 nm, 90 nm                      |
| Intel Pentium Dual-Core | 2006 - 2009     | 1.6 GHz - 2.93 GHz  | 45 nm, 65 nm                      |
| Intel Pentium (2009)    | 2009-present    | 1.2 GHz - 3.33 GHz  | 14 nm, 22 nm, 32 nm, 45 nm, 65 nm |
| Intel Core              | 2006 - 2008     | 1.06 GHz - 2.33 GHz | 65 nm                             |
| Intel Core 2            | 2006 - 2011     | 1.06 GHz - 3.33 GHz | 45 nm, 65 nm                      |
| Intel Core i3           | 2010-present    | 1.2 GHz - 3.7 GHz   | 14 nm, 22 nm, 32 nm               |
| Intel Core i5           | 2009-present    | 1.06 GHz - 4.2 GHz  | 14 nm, 22 nm, 32 nm, 45 nm        |
| Intel Core i7           | 2008-present    | 1.6 GHz - 4.4 GHz   | 14 nm, 22 nm, 32 nm, 45 nm        |
| Intel Core i7           | 2011-present    | 3.0 GHz - 4.0 GHz   | 14 nm, 22 nm, 32 nm               |

# EVOLUTION OF MICROPROCESSORS

## HOW INTEL MANUFACTURES CHIPS



[https://www.youtube.com/watch?v=4oQoZF\\_KRCc](https://www.youtube.com/watch?v=4oQoZF_KRCc)

**THANK YOU**

THANK YOU

