MICRO PROCESSOR
&
MICRO CONTROLLER

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PROCESSOR

- A processor is a logic circuitry (or) electronic device responds to and processor the basic instructions that drive a computer.

MICRO PROCESSOR

- Incorporates the functions of a computers central processing unit (CPU) on single IC (or) at most a few IC's.

(or)

- µp is programmable Ic device that has computing and decision making capability

- The processor is multipurpose , programmable device that accepts digital data as input processes it according to instructions stored in its memory and provides result as o/p.
- (eg:- sequential logic)

- µp is program controlled device which fetches ,decodes , and executes instructions.

- The µp reads instructions from memory communicates with all peripherals (memory & i/p ‘s) using the system bus excepts instruction.

- The µp controls the timing of information flow performs the computing tasks specified in a program.

HISTORY OF μP

- First 4-bit μp 4004 from INTEL corporation in 1971 which has revolution in distal system design.
- First 4-bit μp 4004 contained ten thousands (10,000) transistors
- After 4-bit μp 4004 ,immediately from INTEL corporation in 1972 first 8-bit μp 8008 which are not successful.
- In 1974 from INTEL corporation first 8-bit μp 8080 general purpose μp in which CPU was not functionally successful.
- Later on first 8-bit μp 8085 functionally complete CPU introduced in 1977

- The 8085 μp CPU is still most popular one amongst all 8-bit CPU which provides good performance utilizing an optimum set of registers and an reasonably powerful ALU, where 8085 houses on chip clock generator.

- The major limitations of 8-bit μp are their limited memory addressing capacity ,slow speed of exception limited scratched register and non availability complex instructions and addressing modes

- First 16-bit μp 8086 from INTEL corporation in 1978 which is more powerful efficient computing machine.

EVOLUTION OF μP'S

- First 4-bit μp 4004 from INTELL corporation in 1971.
- Intel developed an improved 4-bit μp 4004,enchanced versions of intel 4004 many other companies also introceduced 4-bit μp such as PPS-4 by ROCKWELL international ,T3472 by Toshiba etc.,
- INTEL corporation in 1972 first 8-bit μp 8008 which so far used PMOS technology these technology of P-MOS used is slow and not compatiable with TTL circuits.
- In 1974 from INTEL corporation first 8-bit μp 8080 general purpose μp used N-MOS technology and was faster and compatible with TTL circuits, these NMOS processor offers higher density than PMOS process.
- The draw backs of 8080 was that it is required 3-power supplies

- In 1976 Intel introduced 8-bit µp 8085 which required only one +5V power supply.
- 8-bit µp 's are Motorola MC6800,MC6809,Zilogs Z80,Z800
- MOS technologies 6500 series , National semiconductors (NSC 800) and Rockwell international PPS-8
- First 16-bit µp 8086 from INTEL corporation in 1978.
- Some other 16-bit µp are intel 80186,intel 8088,intel 80188,intel 80286, Motorolas MC6800,68010,68012, Fairchild 9440, zilogs Z800, national semi conductor PACE INS8900. these used HMOS (High speed density MOS)technologies.

- HMOS offers better speed power product (SPP) higher packing density than NMOS.
- speed power product (spp) = speed * power
  = nanoseconds * mill watts
  = pico joules
- spp of HMOS is 4-times better than NMOS
- circuitry density provided by HMOS (4128 gates /µm square) are approximately twise these of NMOS (1852 -5 gates/ µm square)
- intel 8088 was very popular and was used in costlier and more powerful personal computer

- In 1980 many 32 bits mp's have been introduced .
- Intel introduced its first 32 bits mp IAPX432 not popular
- IN 1985 intel introduced more powerful 32 bit Intel 80386 used in desktops
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- Some other 32- bits mps are INTEL 80486, Pentium, Pentium pro ,Pentium II , Pentium III , Pentium IV,
- Advanced Micro Devices (AMD) K5,K6,K7
- National semiconductors 32032,32332,32C532
- Intel 486 was very popular and widely used for desktops.

8-bit micro processor	16-bit micro processor
1. Simple architecture 2. Slow speed of execution 3. Low memory addressing capability 4. Less powerful instruction set 5. Fabricated using PMOS & NMOS technologies 6. applications:- Data acquisitation systems , numerical control ,automatic testing system 7. Limited no:- of general purpose register	1. Advanced Architecture 2. More processing capability 3. Larger memory addressing capability 4. More powerful instruction set 5. Fabricated using HMOS technologies 6. Applications :- control systems ,traffic controllers, intelligent terminals & instructions 7. More no:- of GPR's

Historical processor	Year	Transistor no:-	Clock speed	Address bits	Data bus in bits	Addressable memory
4004	1971	2300	108 Khz	10	4	640 bytes
8008	1972	3500	200khz	14	8	16 kbytes
8080	1974	6000	2 mhz	16	8	64 kbytes
8085	1976	6500	3 mhz	16	8	64 kbytes
8086	1978	29000	5 mhz	20	16	1 MB
8088	1979	29000	5 mhz	20	8	1MB
80286	1982	1,34,000	8 mhz	24	16	16 mega
80386	1985	2,75,000	16 mhz	32	32	4 giga
80486	1988	1.3mega	25 mhz	32	32	4 Giga
Pentium	1993	3.1 meg	60 mhz	32	32/64	4 giga
Pentium pro	1995	3.5 meg	150 mhz	32	32/ 64	64 giga
Pentium II	1997	8.8 meg	230 mhz	36	64	64 giga
Pentium III	1999	9.5 meg	650 mhz	36	64	64 giga
Pentium IV	2000	4.2 meg	1.4 ghz	36	64	64 giga

Register organization of 8086

- 8086 has powerful set of registers known as
- 1. **general purpose registers** and
- 2. **special purpose registers.**

- All are 16-bit registers

- The general purpose registers can be used as either 8-bit OR 16-bit registers which are used for holding data , variable and immediate results temporarily (or) for other purpose like a counter (or) for storing Offset address for particular address.

- **special purpose registers.:-**
  - Used as segment registers , pointers , index registers (or) Offset storage registers for particular addressing.
  - The registers are categorized in to **4- GROUPS**
  - **A) GENERAL DATA REGISTERS**
  - **B) SEGMENT REGISTER**
  - **C) POINTERS AND INDEX REGISTERS**
  - **D) FLAG REGISTERS**

a) GENERAL DATA REGISTERS

AX	AH	AL	ACCUMULATOR
BX	BH	BL	BASE REGISTER
CX	CH	CL	COUNT REGISTER
DX	DH	DL	DATA REGISTER

AX , BX, CX, DX stands for 16-bit registers

AH,BH,CH,DH stands for (HIGHER 8- bit registers)

AL,BL,CL,DL stands for (LOWER 8-BIT REGISTERS)

- “AX” is a 16-bit **ACCUMULATOR** with lower 8-bit is designated as ‘AL’ and Higher 8-bit as ‘AH’ .this is most important GPR (general purpose register) having multiple functions.

- The ‘BX’ 16-bit register having higher and lower 8-bit (BL, BH) which is used as an Offset storage for forming physical address in case of certain addressing modes.

- The ‘CX’ 16-bit register is used as default counter in case of string and loop instructions.

- The ‘DX’ 16-bit register is used as a implicit operand (or) destination in case of few instructions.

B) SEGMENT REGISTER

- The complete 1MB of a mp's 8086 address is divided in to 16-logical segments.
- Each segment thus contain 64kbytes of memory

  - There are **4 segment registers**

Code segment	**CS**
Stack segment	**SS**
Data segment	**DS**
Extra segment	**ES**

- A) CODE SEGMENT:-
  - Is used for addressing a memory location in code segment of the memory where executable program is stored.

B) DATA SEGMENT:-

this type of register points to data segment of the memory where the data is resided.

C) EXTRA SEGMENT:-

this segment which is essential to another data segment of the memory thus Extra segment also contain data.

D) STACK SEGMENT:-

used for addressing stack segment memory i.e. Memory in which is used to store stack data. The cpu uses stack for temporarily storing important data

C) POINTERS & INDEX REGISTERS

- The pointer contain offset within the particular segment.
- The pointers & index registers are categorized in to following types .

SP	STACK POINTER
BP	BASE POINTER
SI	SOURCE INDEX
DI	DESTINATION INDEX
IP	INSTRUCTION POINTER

A)STACK POINTER:-

Used to hold address of stack top. Stack top is upper most filled memory location in stack memory.

B) BASE POINTER:-

Acts as a memory pointer to stack segment register where BP is manly used to access any location directly in the stack.

C) SOURCE INDEX & DESTINATION INDEX:-

Acts as memory pointer relative to segment register DS. The mp's will take Effective address of the data from SI and stores in DI (INDEX register used in string manipulation).

D) INSTRUCTION POINTER:-

The offset address of the next instruction is contained in IP . That is IP points to next instruction be fetched from code segment.

D) Flag registers

- The 8086 flag register content indicates the result of compilation in the ALU .
- IT contains some flag bits to control the CPU.