Microprocessor Architecture and its application

The microprocessor is programmable logic devices designed with register, flip flops and timing elements. The microprocessor has a set of instruction designed internally to manipulates data and communicate with peripherals.

The process of data manipulation and communication is determined by the logic design of the microprocessor, called the architecture.

The microprocessor can be programmed to perform functions on given data by selecting necessary instructions from its set. There instructions are given to the microprocessor by writing them in to its memory .The microprocessor reads or transfer each instruction one at a time matches it with its instruction set and perform the data manipulation indicated by the instruction. The result can be stored in memory or sent to such output devices as LED's or CRT terminals.

In addition the microprocessor can respond to external signals. It can be interrupted, reset or asked to wait to Synchronize with slower peripherals.

To perform various operations the microprocessor requires registers, an arithmetic logic unit (ALU) and control logic internal buses (paths for information flow).

Registers in the INTEL 8085

A(8)	
B(8)	C(8)
D(8)	E(8)
H(8)	L(8)
PC(16)	
SP(16)	

S	Z	AC	P	CY

It has one 8 bit accumulator a six 8 bit GPR's, B, C, D, E, H and L to store 8 bit data during a program execution. The GPR's (General purpose registers) are also accessible as three 16 bit register-pairs BC, DE, and HL.

Program Counter (PC):-

The PC is used to store the address of the instruction to be executed next. The execution of a program is initiated by loading the PC by the address of the first instruction of the program. Once the first instruction is executed, the PC is automatically incremented to point to the next instruction, unless a jump to some specific address is necessary. This process is repeated till the end of the program.

Accumulator

The accumulator is an 8-bit register that is part of the ALU. This register is used to store 8-bit data and to perform arithmetic and logical operations. The result of an operation is stored in the accumulator.

Flags

The ALU includes five flip flops that are set or reset according to data conditions in the accumulator and other registers.

The 8085A has five flags to indicate five different types of data conditions. They are called zero (Z), Carry (CY), sign(S), parity (P) and auxiliary carry (AC) flags. For example, after an addition of two numbers if the sum in the accumulator is larger then eight bits, the flip flop that is used to indicate a carry called the carry flag (CY) is set to one.

When an arithmetic operation results in zero the flip flop called the zero flag (Z) is set to one.

Stack Pointer.

The stack pointer is also a 16 bit register used as a memory pointer. It points to a memory location in R/ W memory called the stack. The data written first can be accessed last. One can put data on the top of the stack by the special operation known as PUSH. Data can be read out from top of the stack by another special operation known as POP.

Registers not accessible to the programmer

These registers are utilized by the ALU and control section for temporary storage of instruction or operand or address at various stages of instruction execution.

(A) Memory Address registers (MAR)

The address information to be communicated to the out side world is temporally stored in MAR.

(B) Instruction Register (I R)

An instruction fetch from memory is temporarily stored in the (IR) prior to its decoding.

(C) Temporary Register- The ALU section is provided with one or few temporary register to be used as scratch pad for performing various arithmetic and logical operation.

The arithmetic and logic unit- The most common operation performed by ALU of an MPU are as follows.
Arithmetic → addition subtraction, increment, decrement
Compare → *greater than (>), less than (<), greater than equal to (>=), less than equal to (<=).*
Logical → AND, OR, XOR, XNOR, NAND, SHIFT, ROTATE, CLEAR

The interface section

MPU chips are equipped with a number of pins for communication with out side world. This is known as system bus.

Bus line

Bus lines are of the following types→
(A) Address bus (B) Data bus (C) Control bus (D) utility lines
1. Address bus→ The address bus is a group of sixteen lines generally identified as A_0 to A_{15}.The address bus is unidirectional; bits flow in one direction - from the MPU to peripheral devices.
In a computer system each memory location is identified with a binary number, called an address and the address bus is used to carry 16 bit address. The 8085A MPU with its 16 address lines is capable of addressing 2^{16}=65,536(=64K) memory location

2. Data Bus→ The data bus is a group of eight lines used for data flow .These lines are bidirectional - data flow in both direction between the µP and peripheral devices. It determines the word length and register size of a microprocessor, the 8085A microprocessor is called an 8 bit microprocessor.
3. Control bus→ Control bus is responsible for receiving and generating various signals for co-ordination and control of various operations involving external devices.
External devices can initiate the following operations, for which individual pins on the microprocessor chip are assigned reset, interrupt, ready, hold.
(a) **Reset→** when the reset is activated all internal operation are suspended and the program counter is cleared.
(b) **Interrupt→** The microprocessor can be interrupted from the normal execution of instruction and asked to execute some other instruction called service routine

(c) **Ready→** The 8085A has a pin called READY. If the signal at this READY pin is low, the microprocessor enters into a wait state. This signal is used primarily to synchronize slower peripherals with the microprocessor.

(d) **Hold→**. When HOLD pin is activated by an external signal the microprocessor relinquishes control of buses and allows the external peripheral to use them. For example the HOLD signal is used in direct memory access (DMA) data transfer.

The increment /decrement is associated with the register array and allow each register to be incremented (increased by 1) or decremented (decreased by1) independent of the ALU and accumulator.

The 8085A operators on single 5V supply .The required clock signals are created internally by connecting an external crystal between x1 and x2 .Also 8085 has a serial input data (SID) and serial output data (SOD) capability for use simple forms of serial communication such as a TELETYPE.