Microprocessor

Lecture 16

Microprocessor Architecture and its Operation
**Microprocessor Architecture and it's Operation**

Computer system consist primary of: -

1- Microprocessor.

2- Memory.

3- Input.

4- Output.

The internal logic design of the microprocessor called its "architecture", determine how and what various operations are performed by "Mp".

*Microprocessor architecture and its operations:*

The microprocessor is programmable logic device designed with register, flip-flop and timing elements.

All function performed by microprocessor can be classified in three general categories: -

1- Microprocessor initiated operations.

2- Internal data operations.

3- Peripheral (or externally) initiated operations.

To performed these operations, microprocessor needs [logic circuit and control signals].

**1- Mp Initiated Operations:**

Primarily microprocessor performs **four** operations: -

a) Memory read (Reads data from memory).

b) Memory writes (Write data into memory).

c) I/O read (Accept data to output device).

d) I/O writes (Sends data to output device).
These operations are part of the communication process. The microprocessor needs to perform the following steps:

1. Identify the peripheral (memory location).
2. Transfer data.
3. Provide timing or synchronization signals.

Microprocessor performed these functions using sets of buses [Data bus, Address bus, Control bus].

1. **Data bus**: is a group of 8 lines used for data flow, these lines are bidirectional from (00 – FF) = $2^8 = 256$ numbers.

   *The largest number = 1111 1111 = FF, thus 8085 Mp is called 8 bit Mp.

2. **Address bus**: is a group of 16 lines, identified as $A_0 - A_{15}$. This bus is unidirectional (bit flow in one direction) from Mp to peripheral.

   *Each memory location or peripheral identified with binary number called address. ($2^{16} = 65536 = 64K$).

3. **Control bus**: the control is comprised of various single lines that carry synchronization signals.
To communication with a memory, for example to read instruction from memory location:—

1- Mp placed 16-bit address on address bus.

2- The address on the bus is decoded by an external logic circuit.

3- The memory location is identified.

4- The Mp sends a pulse called memory read as control signal.

5- The pulse activates the memory chip.

6- The contents of the memory location (8-bit data) are placed on the data bus as in fig. (2).
2- **Internal Data Operations:-**

The internal architecture of the 8085/8080A microprocessor determines how and what operation can be performed with the data. These operations are:

1. Store 8-bit data.
2. Performed arithmetic and logical operations.
3. Test for conditions.
4. Sequence the execution of instructions.
5. Store data temporarily during execution in the defined R/W memory locations called the stack.

*To perform these operations the Mp requires:-*

a) Registers.

b) An arithmetic logic unit (ALU) & control logic.

c) Internal buses (paths for information flow).
A) Registers:

The 8085 has 6 general purpose registers to perform its operation (store 8-bit data during program execution) these are:

**(B, C, D, E, H & L) or in pair (BC, DE & HL)** to perform 16-bit operations it could be viewed as memory locations.

B) Accumulator:

8-bit register that is part of (ALU), this register used to stored 8-bit data to perform arithmetic & logic operation, the result of operation is stored in the accumulator.

C) Program counters (pc):

This 16-bit register used in sequencing the execution of instructions, this register is memory pointer. The Mp uses this register to sequence the execution of the instruction. The function of the program counter is to point to the memory address for which the next byte is to be fetched.
D) **Stack pointer (sp):**

This 16-bit register used as memory pointer, it point to memory location in R/W memory called (the stack), the beginning of the stack is defined by loading 16-bit address in stack pointer (register).

**Flag – Register:**

The flag register contains 5-bit that are used as flags or indicator.

Any time 8085 executes an arithmetic or logic instruction.

<table>
<thead>
<tr>
<th>S</th>
<th>Z</th>
<th>AC</th>
<th>P</th>
<th>CY</th>
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**Where:**

S mean the sign bit and given:

- **Logic 1** = (-ve).
- **Logic 0** = (+ve).

Z mean zero flag and given:

- **Logic 1** = zero result.
- **Logic 0** = 1 result.

AC mean auxiliary carry and given:

- **Logic 1** = there is a carry from bit 3 to bit 4.
- **Logic 0** = no carry.

P mean parity flag and given:

- **Logic 1** = the number of ones in accumulator is even.
- **Logic 0** = the number of ones in accumulator is odd.
3- Peripheral orExternally Initiated Operations:-

External devices (or signals) can initiate the following operation for which individual pins on Mp chip are assigned: **Reset, Interrupt, Ready, Hold.**

**A) Reset:** when reset is activated all internal operations are suspended and the program counter is cleared.

**B) Interrupt:** the Mp can be interrupted from normal execution and asked to execute other instructions called "service routine" (emergency), Mp resumes its operation after that.

**C) Ready:** 8085 has pin called ready, if the signal is lowMp enters into wait state, this signal used to synchronized slower peripherals with Mp.

**D) Hold:** when hold pin activated by external signal Mp relinquishes control buses and allows the external peripheral to use the. For example:

Hold signal is used in direct memory access data transfer.