EXPERIMENT – 10

AIM

To study the architecture and instruction set of 8085 Microprocessor.

PLATFORM/TOOL USED

- Simulator: https://circuitverse.org/simulator

THEORY

The microprocessor is the CPU (Central Processing Unit) of a computer. It is the heart of the computer. Here, we will describe Intel 8085 as it is one of the most popular 8-bit microprocessor.

8085 is pronounced as "eighty-eighty-five" microprocessor. It is an 8-bit microprocessor designed by Intel in 1977 using NMOS technology.

The size of the data bus of 8085 is 8 bits while that of the address bus is 16. Therefore, can address 64 KB (i.e., 216) memory. Also, as it can perform 8-bit operation thus the size of ALU is also 8-bit.

I. Architecture of 8085 microprocessor

The architecture of 8085 microprocessor provides the idea about what are the operations to be executed and how these are performed.

8085 consists of the following functional units −

1) Accumulator
   It is an 8-bit register used to perform arithmetic, logical, I/O & LOAD/STORE operations. It is connected to internal data bus & ALU.
2) Arithmetic and logic unit
   As the name suggests, it performs arithmetic and logical operations like Addition, Subtraction, AND, OR, etc. on 8-bit data.
3) General purpose register
   There are 6 general purpose registers in 8085 processor, i.e., B, C, D, E, H & L. Each register can hold 8-bit data. These registers can work in pair to hold 16-bit data and their pairing combination is like B-C, D-E & H-L.
4) Program counter
   It is a 16-bit register used to store the memory address location of the next instruction to be executed. Microprocessor increments the program whenever an instruction is being executed, so that the program counter points to the memory address of the next instruction that is going to be executed.
5) Stack pointer
   It is also a 16-bit register works like stack, which is always incremented/decremented by 2 during push & pop operations.
6) Temporary register
   an 8-bit register, which holds the temporary data of arithmetic and logical operations.
7) Flag register
   It is an 8-bit register having five 1-bit flip-flops, which holds either 0 or 1 depending upon the result stored in the accumulator.
   These are the set of 5 flip-flops −
   a) Sign (S)
   b) Zero (Z)
   c) Auxiliary Carry (AC)
   d) Parity (P)
   e) Carry (C)

   Its bit position is shown in the following table −

D7	D6	D5	D4	D3	D2	D1	D0
S	Z		AC		P		CY

8) Instruction registers and decoder

It is an 8-bit register. When an instruction is fetched from memory then it is stored in the Instruction register. Instruction decoder decodes the information present in the Instruction register.

9) Timing and control unit

It provides timing and control signal to the microprocessor to perform operations. Following are the timing and control signals, which control external and internal circuits −

a) Control Signals: READY, RD', WR', ALE
b) Status Signals: S0, S1, IO/M'
c) DMA Signals: HOLD, HLDA
d) RESET Signals: RESET IN, RESET OUT

10) Interrupt control

As the name suggests it controls the interrupts during a process. When a microprocessor is executing a main program and whenever an interrupt occurs, the microprocessor shifts the control from the main program to process the incoming request. After the request is completed, the control goes back to the main program. There are 5 interrupt signals in 8085 microprocessors: INTR, RST 7.5, RST 6.5, RST 5.5, TRAP.

11) Serial Input/output control

It controls the serial data communication by using these two instructions: SID (Serial input data) and SOD (Serial output data).

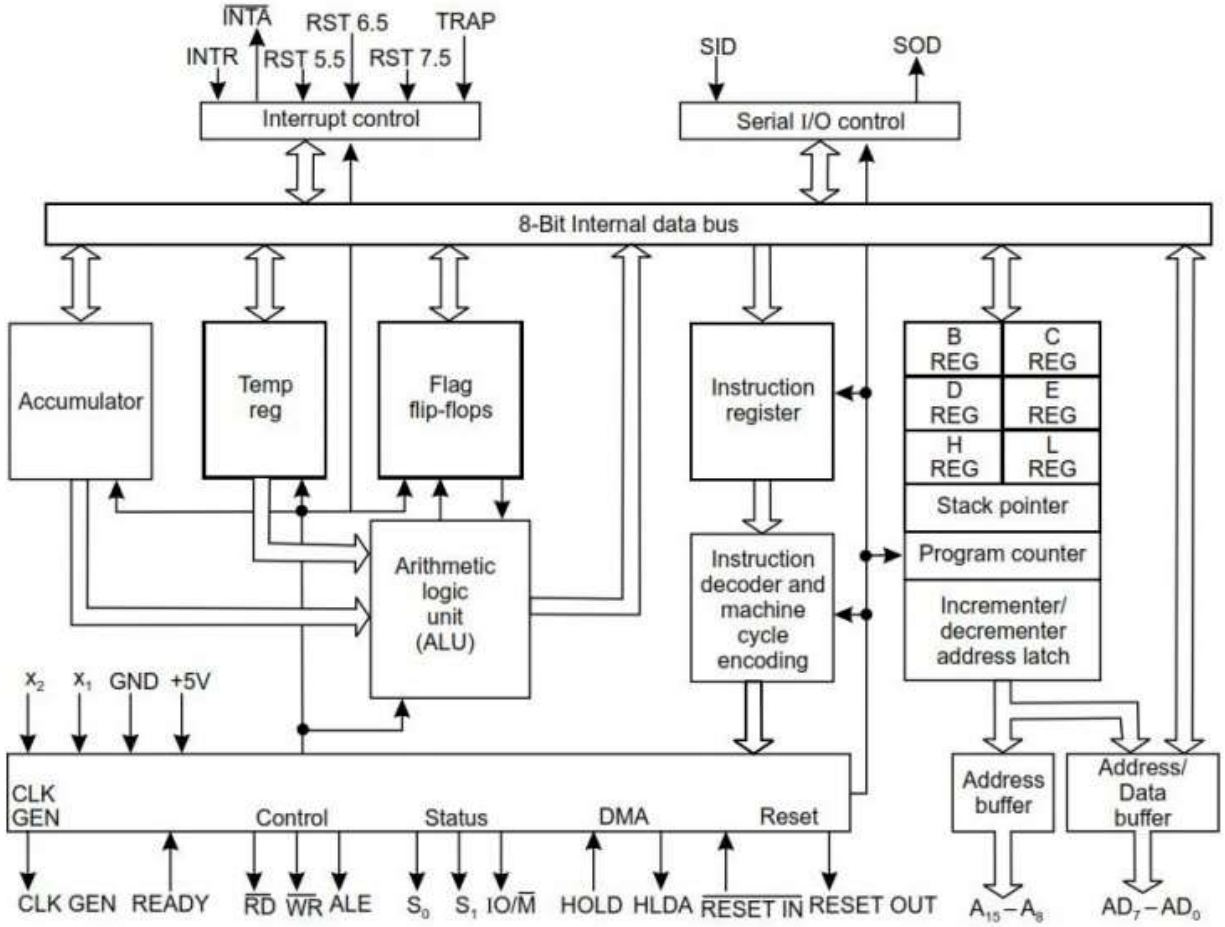
12) Address buffer and address-data buffer

The content stored in the stack pointer and program counter is loaded into the address buffer and address-data buffer to communicate with the CPU. The memory and I/O chips are connected to these buses; the CPU can exchange the desired data with the memory and I/O chips.

13) Address bus and data bus

Data bus carries the data to be stored. It is bidirectional, whereas address bus carries the location to where it should be stored, and it is unidirectional. It is used to transfer the data & Address I/O devices.

Hardware Architecture of 8085 Microprocessor



II. Instruction Set of 8085

- An instruction is a binary pattern designed inside a microprocessor to perform a specific function.
- The entire group of instructions that a microprocessor supports is called Instruction Set.
- 8085 has 246 instructions.
- Each instruction is represented by an 8-bit binary value.
- These 8-bits of binary value is called Opcode or Instruction Byte.

Classification of Instruction Set

1. Data Transfer Instruction
2. Arithmetic Instructions
3. Logical Instructions
4. Branching Instructions
5. Control Instructions

Data Transfer Instructions

- These instructions move data between registers, or between memory and registers.
- These instructions copy data from source to destination.
- While copying, the contents of source are not modified.

Opcode	Operand	Description	Example

MOV	Rd, Rs
	Rd, M
	M, Rs
		Copy from source to destination.	MOV B, C
			MOV B, M
			MOV M, C

MOV	Rd, Rs Rd, M M, Rs	Copy from source to destination.	MVI A, 57H MVI M, 57H
LXI	Reg. pair, 16-bit data	Load register pair immediate	LXI H, 2034 H
LDA	16-bit address	Load Accumulator	LDA 2034H
LDAX	B/D Register Pair	Load accumulator indirect	LDAX B
LHLD	16-bit address	Load H-L registers direct	LHLD 2040 H
STA	16-bit address	Store accumulator direct	STA 2500 H
STAX	Reg. pair	Store accumulator indirect	STAX B
SHLD	16-bit address	Store H-L registers direct	SHLD 2550 H
XCHG	None	Exchange H-L with D-E	XCHG

Arithmetic Instructions

- These instructions perform the operations like:
- Addition
- Subtract
- Increment
- Decrement

Opcode	Operand	Description	Example
ADD	R M	Add register or memory to accumulator	ADD B ADD M
ADC	R M	Add register or memory to accumulator with carry	ADC B ADC M
ADI	8-bit data	Add immediate to accumulator	ADI 45 H
ACI	8-bit data	Add immediate to accumulator with carry	ACI 45 H

DAD	Reg. pair	Add register pair to H-L pair	DAD B
SUB	R M	Subtract register or memory from accumulator	SUB B SUB M
SBB	R M	Subtract register or memory from accumulator with borrow	SBB B SBB M
SUI	8-bit data	Subtract immediate from accumulator	SUI 45 H
SBI	8-bit data	Subtract immediate from accumulator with borrow	SBI 45 H
INR	R M	Increment register or memory by 1	INR B INR M
INX	R	Increment register pair by 1	INX H
DCR	R M	Decrement register or memory by 1	DCR B DCR M
DCX	R	Decrement register pair by 1	DCX H

Logical Instructions

- These instructions perform logical operations on data stored in registers, memory and status flags.
- The logical operations are:
    1. AND
    2. OR
    3. XOR
    4. Rotate
    5. Compare
    6. Complement

Opcode	Operand	Description	Example
CMP	R M	Compare register or memory with accumulator	CMP B CMP M
CPI	8-bit data	Compare immediate with accumulator	CPI 89H
ANA	R M	Logical AND register or memory with accumulator	ANA B ANA M
ANI	8-bit data	Logical AND immediate with accumulator	ANI 86H
XRA	R M	Exclusive OR register or memory with accumulator	XRA B XRA M
ORA	R M	Logical OR register or memory with accumulator	ORA B ORA M
ORI	8-bit data	Logical OR immediate with accumulator	ORI 86H
XRA	R M	Logical XOR register or memory with accumulator	XRA B XRA M
XRI	8-bit data	XOR immediate with accumulator	XRI 86H
RLC	None	Rotate accumulator left	RLC
RRC	None	Rotate accumulator right	RRC
RAL	None	Rotate accumulator left through carry	RAL

RAR	None	Rotate accumulator right through carry	RAR
CMA	None	Complement accumulator	CMA
CMC	None	Complement carry	CMC
STC	None	Set carry	STC

Branching Instructions

- The branching instruction alter the normal sequential flow.
- These instructions alter either unconditionally or conditionally.

Opcode	Operand	Description	Example
JMP	16-bit address	Jump unconditionally	JMP 2034 H
Jx	16-bit address	Jump conditionally	JZ 2034 H
CALL	16-bit address	Call unconditionally	CALL 2034 H
Cx	16-bit address	Call conditionally	CZ 2034 H
RET	None	Return unconditionally	RET
Rx	None	Call conditionally	RZ
RST	0 – 7	Restart (Software Interrupts)	RST 3

Control Instructions

- The control instructions control the operation of microprocessor.

Opcode	Operand	Description	Example
NOP	None	No operation	NOP
HLT	None	Halt	HLT
DI	None	Disable interrupt	DI
EI	None	Enable interrupt	EI
RIM	None	Read Interrupt Mask	RIM
SIM	None	Set Interrupt Mask	SIM

RESULT

The architecture and instruction set of 8085 Microprocessor been studied and analysed.

CRITERIA	TOTAL MARKS	MARKS OBTAINED	COMMENTS
Concept (A)	2		
Implementation (B)	2		
Performance (C)	2		
Total	6		