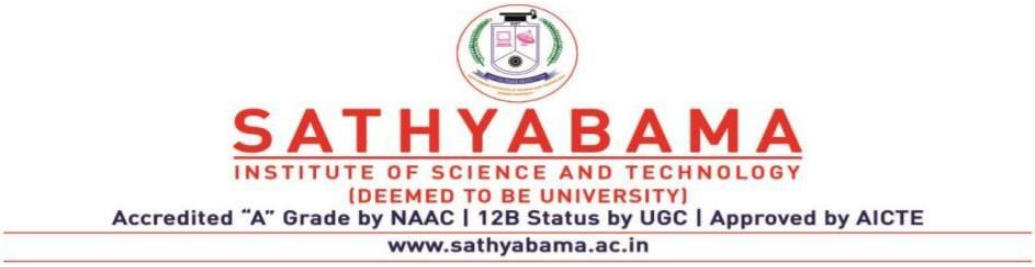


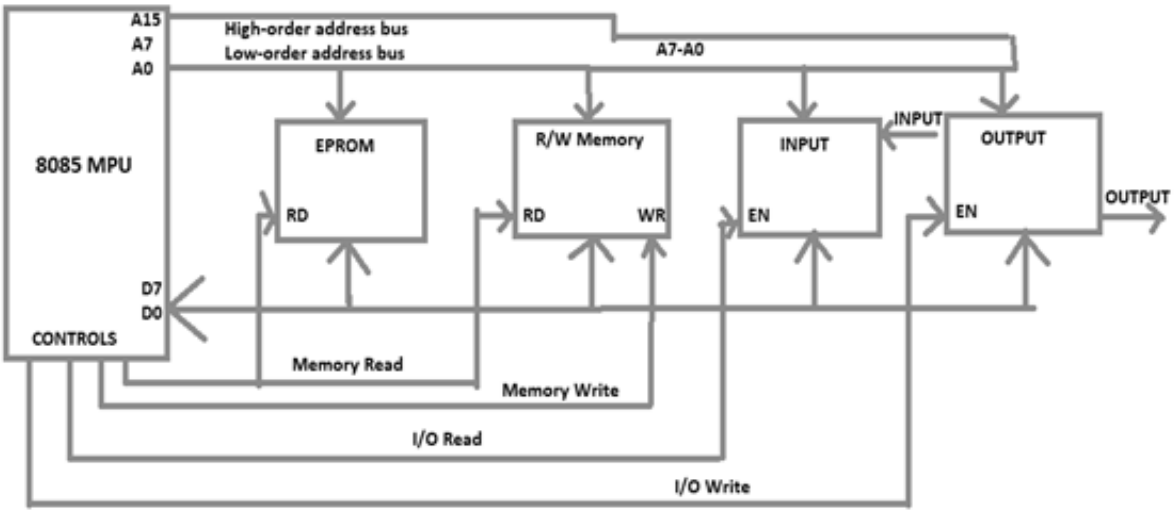
SCHOOL OF COMPUTING

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

UNIT – IV – SBS1203 – COMPUTER ARCHITECTURE

4.1.MICRO COMPUTER

Microcomputer is used to describe a system that includes a minimum of a microprocessor, program memory, data memory, and input–output (I/O). ... Thus, a microcomputer system can be anything from a large computer having hard disks, floppy disks, and printers to a single-chip embedded controller.



A Microcomputer System

4.2.ASSEMBLY LANGUAGE PROGRAMMING

Assembly language programming is low-level **programming** using some basic syntax to represent machine **code** for a specific CPU.

An **assembler** is used to translate the **assembly code** into the machine **code** for the target computer.

A **program** created from assembly can be more efficient and faster than a program created with a compiler.

Each family of processors has its own set of instructions for handling various operations such as getting input from keyboard, displaying information on screen and performing various other jobs. These set of instructions are called 'Machine Language Instructions'.

Assemply Language Program

2000 LDA 2050 A<-[2050]

2003 MOV H, AH<-A

2004 LDA 2051 A<-[2051]

2007 ADD HA<-A+H

2006 MOV L, AL←A

2007 MVI A 00A←00

2009 ADC A A←A+A+carry

200A MOV H, AH←A

200B SHLD 3050 H→3051, L→3050

200 EHLT

4.3.MICROPROCESSORS

It is an 8-bit microprocessor designed by Intel in 1977 using NMOS(N-channel metal-oxide semiconductor is a microelectronic circuit) technology.

It has the following configuration −

8-bit data bus

16-bit address bus, which can address upto 64KB

A 16-bit program counter

A 16-bit stack pointer

Six 8-bit registers arranged in pairs: BC, DE, HL

Requires +5V supply to operate at 3.2 MHZ single phase clock

It is used in washing machines, microwave ovens, mobile phones, etc.

8085 Microprocessor – Functional Units

4.3.1. 8085 consists of the following functional units :

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.

Arithmetic and logic unit

- As the name suggests, it performs arithmetic and logical operations like Addition, Subtraction, AND, OR, etc. on 8-bit data.

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.

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.

STACK POINTER

It is also a 16-bit register works like stack, which is always incremented/decremented by 2 during push & pop operations.

Temporary Register

It is an 8-bit register, which holds the temporary data of arithmetic and logical operations.

Flag Register

R

- 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:

D7	D6	D5	D4	D3	D2	D1	D0

- Sign (S),Zero (Z),Auxiliary Carry (AC),Parity (P),Carry (C)

Its bit position is shown in the following table :

- 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:

- Sign (S),Zero (Z),Auxiliary Carry (AC),Parity (P),Carry (C)

Its bit position is shown in the following table :

S	Z		AC		P		CY

Instruction Register 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.

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 .

- Control Signals: READY, RD, WR, ALE
- Status Signals: S0, S1, IO/M
- DMA Signals: HOLD, HLDA
- RESET Signals: RESET IN, RESET OUT

4.4.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 microprocessor: INTR, RST 7.5, RST 6.5, RST 5.5, TRAP.

4.5.SERIAL INPUT/OUTPUT CONTROL

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

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.

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.

8085 MICROPROCESSOR ARCHITECTURE

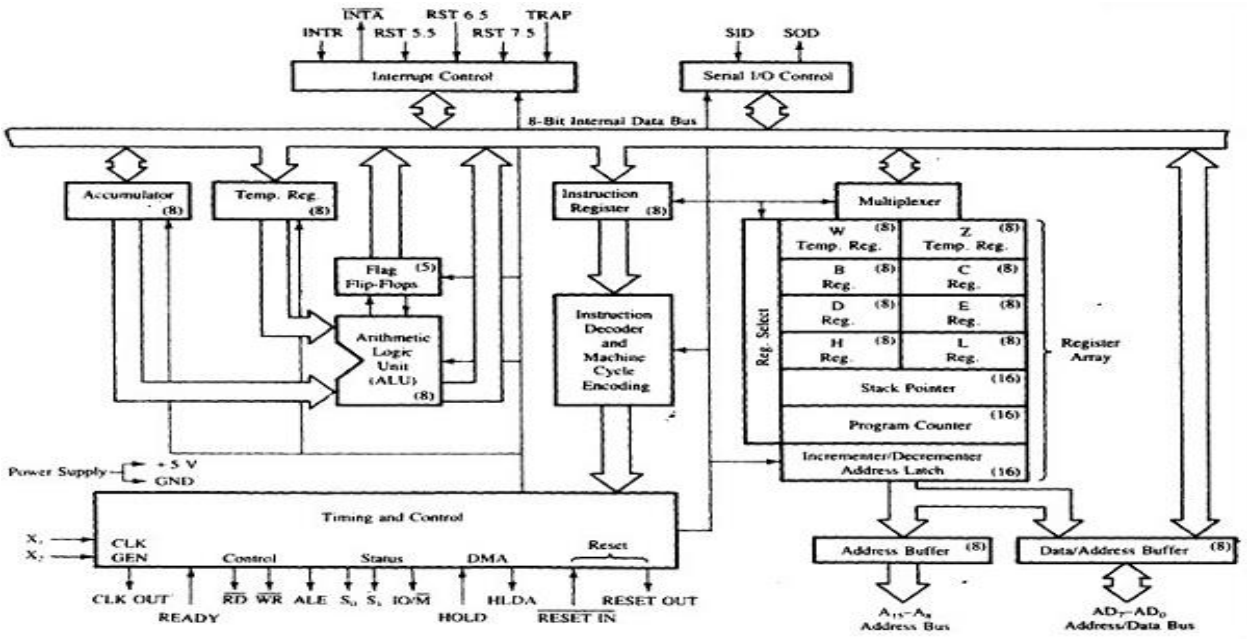


Fig.4.1. Architecture diagram of Microprocessor

The pins of a 8085 microprocessor can be classified into seven groups −

Address bus

- A15-A8, it carries the most significant 8-bits of memory/IO address.

Data bus

- AD7-AD0, it carries the least significant 8-bit address and data bus.

Control And Status Signals

These signals are used to identify the nature of operation. There are 3 control signal and 3 status signals.

Three control signals are RD, WR & ALE.

RD

WR

ALE

RD − This signal indicates that the selected IO or memory device is to be read and is ready for accepting data available on the data bus.

WR − This signal indicates that the data on the data bus is to be written into a selected memory or IO location.

ALE − It is a positive going pulse generated when a new operation is started by the microprocessor. When the pulse goes high, it indicates address. When the pulse goes down it indicates data.

Three status signals are IO/M, S0 & S1.

IO/M

- This signal is used to differentiate between IO and Memory operations, i.e. when it is high indicates IO operation and when it is low then it indicates memory operation.

S1 & S0

- These signals are used to identify the type of current operation.

POWER SUPPLY

- There are 2 power supply signals − VCC & VSS. VCC indicates +5v power supply and VSS indicates ground signal.

CLOCK SIGNALS

There are 3 clock signals, i.e. X1, X2, CLK OUT.

X1, X2 − A crystal (RC, LC N/W) is connected at these two pins and is used to set frequency of the internal clock generator. This frequency is internally divided by 2.

CLK OUT − This signal is used as the system clock for devices connected with the microprocessor.

Interrupts & Externally Initiated Signals

- Interrupts are the signals generated by external devices to request the microprocessor to perform a task. There are 5 interrupt signals, i.e. TRAP, RST 7.5, RST 6.5, RST 5.5, and INTR. We will discuss interrupts in detail in interrupts section.

INTA − It is an interrupt acknowledgment signal.

RESET IN − This signal is used to reset the microprocessor by setting the program counter to zero.

RESET OUT − This signal is used to reset all the connected devices when the microprocessor is reset.

READY − This signal indicates that the device is ready to send or receive data. If READY is low, then the CPU has to wait for READY to go high.

HOLD − This signal indicates that another master is requesting the use of the address and data buses.

HLDA (HOLD Acknowledge) − It indicates that the CPU has received the HOLD request and it will relinquish the bus in the next clock cycle. HLDA is set to low after the HOLD signal is removed.

SERIAL I/O SIGNALS

There are 2 serial signals, i.e. SID and SOD and these signals are used for serial communication.

SOD (Serial output data line) − The output SOD is set/reset as specified by the SIM instruction.

SID (Serial input data line) − The data on this line is loaded into accumulator whenever a RIM instruction is executed.

8085 INSTRUCTION SET

Instruction set classified into 5 categories:

- CONTROL INSTRUCTIONS
- LOGICAL INSTRUCTIONS
- BRANCING ARTHMETIC INSTRUCTIONS
- DATA TRANSFER INSTRUCTIONS

Control Instructions

- NOP, HLT, DI,EI,RIM, SIM

Logical Instructions

- CMP,CPI,ANA,ANI,XRA,XRI,RLC,
- RRC, RAL,RAR,CMA,CMC,STC

Branching Instructions

- JMP,RET,PCHL,RST

Arithmetic Instructions

- ADD,ADC,ADI,ACI,LXI,DAD,SUB,SBB,SUI,SBI,INR,DCX,
- DAA

Data Transfer Instructions

- MOV,MVI,LDA,LDAX,LXI,LHLD,STA,STAX,SHLD,XCHG,
- SPHL,PUSH,POP,OUT,IN