Microprocessor
Lecture 2

Introduction to Microprocessor

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Definition

How do you define microprocessor??

- It is a programmable logic device
- It is a data processing unit as computing unit of a computer
- It is a programmable integrated device with decision making capability similar to that of a CPU

General Definition

- " A microprocessor is a multipurpose, programmable, clock driven, register based electronic device that reads binary input as instructions from storage device called memory, processes the data according to the instructions and provides the results as output"

- Three basic characteristics that differentiate the microprocessors
  1. Instruction set : no. of instruction
  2. Bandwidth: no. of bits processed in a single instruction
  3. Clock speed: how many instruction per second?

A typical programmable machine

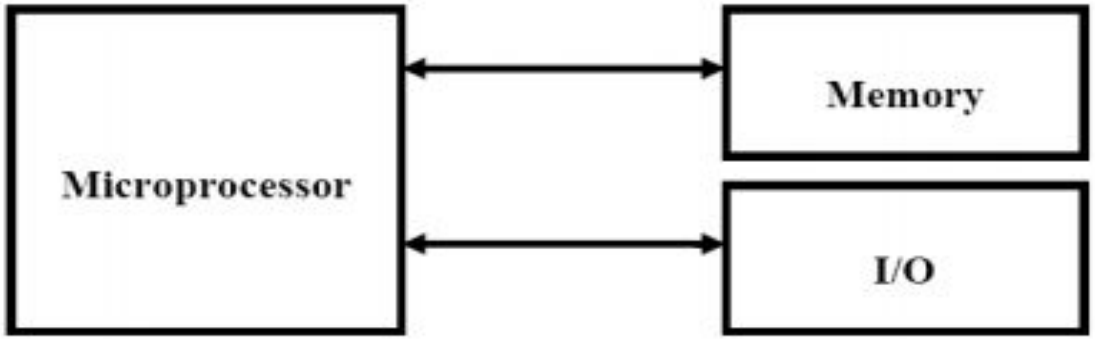

Figure: A Programmable Machine

It consists of:

1. Microprocessor
2. Memory
3. Input device
4. Output device

Microprocessor Based System

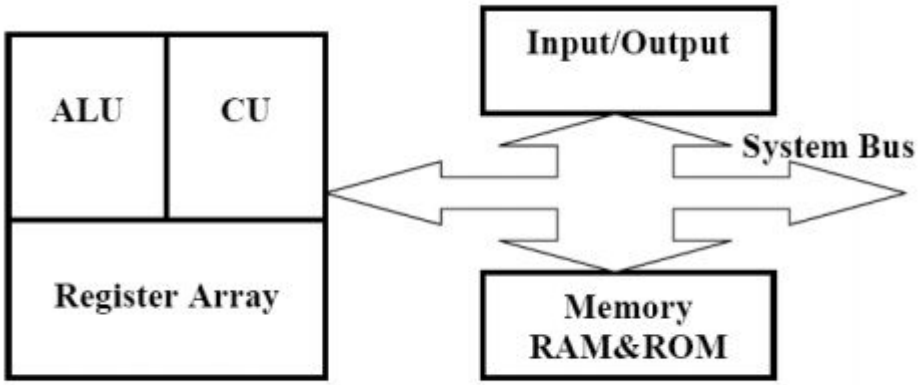

Figure: Microprocessor Based System with Bus Architecture.

1. CPU: consists of ALU, CU and the Register arrays collectively known as Central Processing unit
    a. ALU is in charge of all mathematical and logical operation
    b. CU overall handles the control flow and timings of all the processes
    c. Register array holds the data temporarily
2. Data is fed through input device and collected via output devices
3. RAM and ROM helps to store the data as memory
4. The system bus carries the information (data and address) to and from the memory devices to the CPU.

MICROCOMPUTER

- As the name implies, Microcomputers are small computers
- They range from small controllers that work directly with 4-bit words to larger units that work directly with 32-bit words
- Some of the more powerful Microcomputers have all or most of the features of earlier minicomputers.
- Examples of Microcomputers are Intel 8051 controller-a single board computer, IBM PC and Apple Macintosh computer.

MICRO CONTROLLER

- Single-chip Microcomputers are also known as Microcontrollers.
- They are used primarily to perform dedicated functions.
- They are used primarily to perform dedicated functions or as slaves in distributed processing.

The Difference :

Microprocessor

- Microprocessor is a silicon chip which includes ALU, register circuit and control circuits.
- Normally used for general purpose computers as CPU.
- The performance speed, i.e. clock speed of microprocessor is higher ranging frequency from MHz to GHz.
- Addition of external RAM, ROM and I/O ports makes these systems bulkier and much more expensive.
- Microprocessors are more versatile than microcontrollers as the designers can decide on the amount of RAM, ROM and I/O ports needed to fit the task at hand. E.gs. Intel 8085, 8086, Motorola 68000, Intel Core i7, etc.

Microcontroller

- Microcontroller is a silicon chip which includes microprocessor, memory and I/O in a single package.
- Normally microcontrollers are used for specific purposes (embedded system) e.g. traffic light controller, printer, etc.
- The performance speed of microcontroller is relatively slower than that of microprocessors, with clock speed from 3-33 MHz.
- Has fixed memory and all peripherals are embedded together on a single chip, so are not bulkier and are cheaper than microprocessors.
- As microcontrollers have already fixed amount of RAM, ROM and I/O ports, so are not versatile as the user cannot change the amount of memory and I/O ports. E.gs. AT89C51, ATmega32, AT89S52, etc.

APPLICATIONS OF MICROPROCESSOR

- Microcomputers
- Industrial Control
- Robotics
- Traffic Lights
- Washing Machines
- Microwave Oven
- Security Systems
- On Board Systems

Stored Program Concept

- On the basis of storing programs and data, we categorize the machines as:

1. Von Neumann Architecture
2. Harvard Architecture

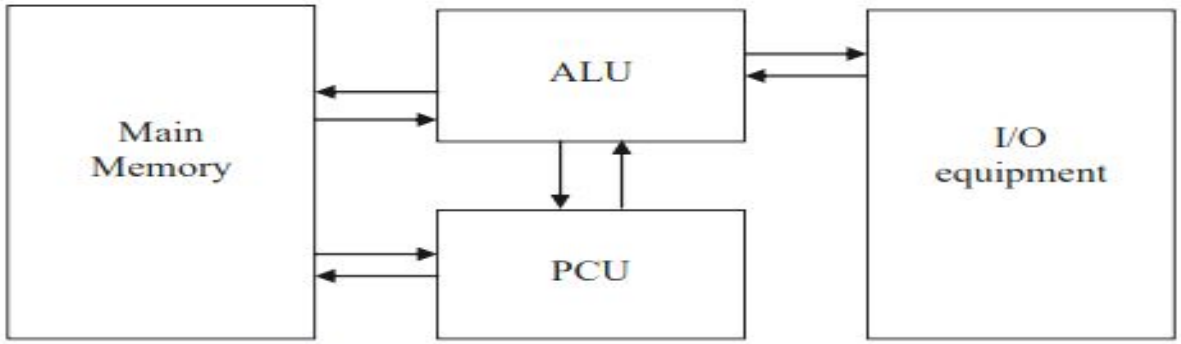

Figure: Von Neumann architecture

Stored Program Concept (Von Neumann)

1. The stored program concept was first adopted by John von Neumann
2. Main memory is used to store both data and instruction
3. The ALU performs arithmetic and logical operation
4. Various registers on this model are:
   - MBR(Memory Buffer Register)
   - MAR(Memory Address Register)
   - IR(Instruction Register)
   - IBR(Instruction Buffer Register)
   - PC(Program Counter)
5. The same memory is used for storing instructions and data and a single bus is used for reading or writing data and instructions to and from the memory
6. It limited the processing speed of computer
7. Hence Harvard architecture was introduced

Stored Program Concept (Harvard Architecture)

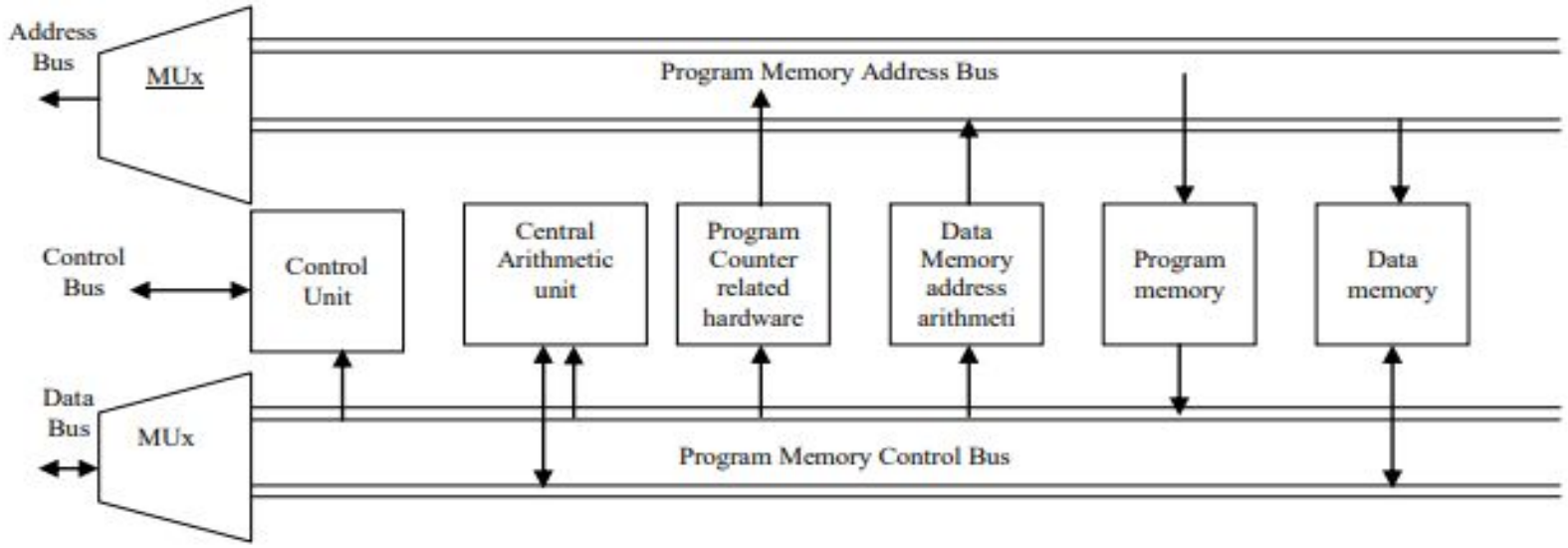

Fig: Block diagram of a Harvard architecture based microprocessor

- Unlike Von Neumann, it uses separate memory for storage of program and data
- Each memory has separate address and data bus
- As a result both program and data can be fetched simultaneously from memory
- Program memory data bus is multiplexed with data memory
- Program memory address bus and data memory address bus are multiplexed
- Two RAM chips : Program memory and Data memory space
- Faster and sophisticated but costlier

8085 Microprocessor

- It is a 8-bit microprocessor
- Capable of addressing 64K memory (16-bit address lines, Uni-directional)
- 8- bit data bus (Bi-directional)
- Has 40 pin DIP(Dual Inline Package)
- Requires +5v power supply
- Minimum clock of 500Khz to maximum of 3Mhz
- Has 246 instruction sets

- Data and address are in Hexadecimal notation as
  - Data (From 00H to FFH)
  - Address (From 0000H to FFFFH)
  - i.e. If we convert to binary we get 4 bits for each hex as " 0000 0000" which is 8 bit

Thank you