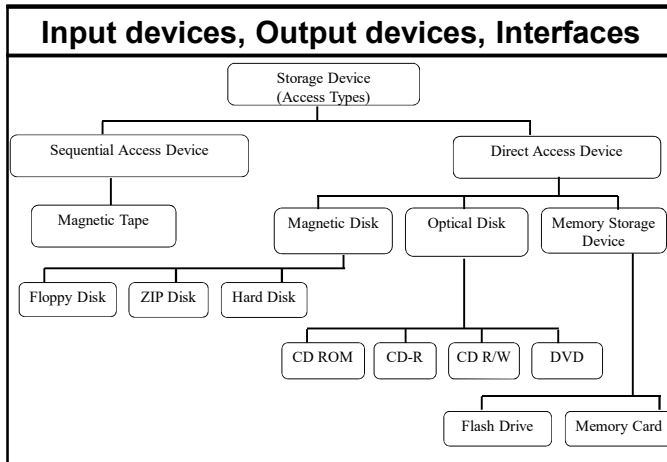
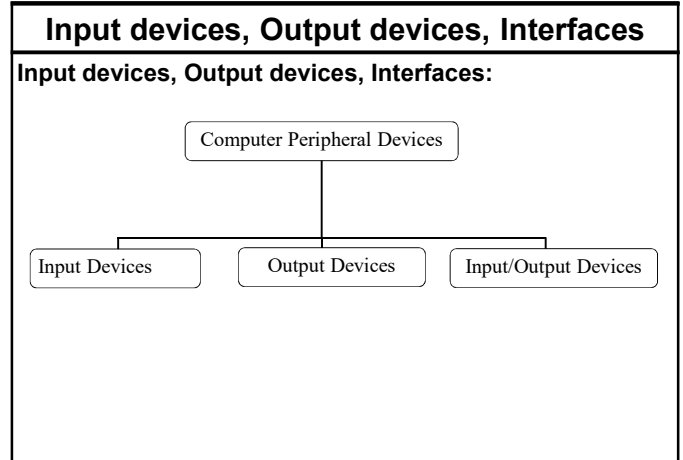


Course Contents
Unit-04:Input and Output Devices (4 Hrs.)
<ul style="list-style-type: none"> • Introduction; • Input-Output Unit; • Input Devices; • Human Data Entry Devices; • Source Data Entry Devices; • Output Devices; • I/O Port; • Working of I/O System



- Input devices, Output devices, Interfaces**
- Input devices, Output devices, Interfaces:**
- An input device sends information to a computer system for processing, and an output device reproduces or displays the results of that processing.
 - Input devices only allow for input of data to a computer and output devices only receive the output of data from another device.
 - Most devices are only input devices or output devices, as they can only accept data input from a user or output data generated by a computer.
 - However, some devices can accept input and display output, and they are referred to as I/O devices (input/output devices).

Input devices, Output devices, Interfaces

Input devices:
 An input device can send data to another device, but it cannot receive data from another device. Examples of input devices include the following.

- Keyboard and Mouse - Accepts input from a user and sends that data (input) to the computer. They cannot accept or reproduce information (output) from the computer.
- Microphone - Receives sound generated by an input source, and sends that sound to a computer.
- Webcam - Receives images generated by whatever it is pointed at (input) and sends those images to a computer.

- Input devices, Output devices, Interfaces**
- Types of input devices:**
- | | |
|--|--|
| <ul style="list-style-type: none"> • Audio conversion device • Barcode reader • Biometrics (e.g., fingerprint scanner). • Business card reader • Digital camera and digital camcorder. • EEG (electroencephalography) • Finger (with touch screen or Windows Touch). • Gamepad, joystick, paddle, steering wheel, and Microsoft Kinect. • Gesture recognition • Graphics tablet • Keyboard • Light gun • Light pen • Magnetic ink (like the ink found on checks). • Magnetic stripe reader • Medical imaging devices (e.g., X-ray, CAT scan, and ultrasound images). • Microphone (using voice speech recognition or biometric verification). | <ul style="list-style-type: none"> • MIDI keyboard • MICR • Mouse, touchpad, or other pointing devices. • OMR (optical mark reader) • Paddle • Pen or stylus • Punch card reader • Remote • Scanner • Sensors (e.g., heat and orientation sensors). • Sonar imaging devices • Stylus (with touch screen). • Touch screen • Voice (using voice speech recognition or biometric verification). • Video capture device • VR helmet and gloves • Webcam • Yoke |
|--|--|

Input devices, Output devices, Interfaces	
Types of input devices:	
<ul style="list-style-type: none"> • Audio conversion device • Barcode reader • Biometrics (e.g., fingerprint scanner). • Business card reader • Digital camera and digital camcorder. • EEG (electroencephalography) • Finger (with touch screen or Windows Touch). • Gamepad, joystick, paddle, steering wheel, and Microsoft Kinect. • Gesture recognition • Graphics tablet • Keyboard • Light gun • Light pen • Magnetic ink (like the ink found on checks). • Magnetic stripe reader • Medical imaging devices (e.g., X-ray, CAT scan, and ultrasound images). • Microphone (using voice speech recognition or biometric verification). 	<ul style="list-style-type: none"> • MIDI keyboard • MICR • Mouse, touchpad, or other pointing devices. • OMR (optical mark reader) • Paddle • Pen or stylus • Punch card reader • Remote • Scanner • Sensors (e.g., heat and orientation sensors). • Sonar imaging devices • Stylus (with touch screen). • Touch screen • Voice (using voice speech recognition or biometric verification). • Video capture device • VR helmet and gloves • Webcam • Yoke

Computer Architecture
Output devices:
<p>An output device can receive data from another device and generate output with that data, but it cannot send data to another device. Examples of output devices include the following.</p> <ul style="list-style-type: none"> ▪ Monitor - Receives data from a computer (output) and displays that information as text and images for users to view. It cannot accept data from a user and send that data to another device. ▪ Projector - Receives data from a computer (output) and displays, or projects, that information as text and images onto a surface, like a wall or a screen. It cannot accept data from a user and send that data to another device. ▪ Speakers - Receives sound data from a computer and plays the sounds for users to hear. It cannot accept sound generated by users and send that sound to another device.

Input devices, Output devices, Interfaces	
Types of output devices	
<ul style="list-style-type: none"> ▪ 3D Printer ▪ Braille embosser ▪ Braille reader ▪ COM (Computer Output Microfilm) ▪ Flat-panel ▪ GPS ▪ Headphones ▪ Monitor ▪ Plotter ▪ Printer (dot matrix printer, inkjet printer, and laser printer) 	<ul style="list-style-type: none"> ▪ Projector ▪ Sound card ▪ Speakers ▪ SGD (Speech-generating device) ▪ TV ▪ Video card

Input devices, Output devices, Interfaces
Input/output devices:
<p>An input/output device can receive data from users, or another device (input), and send data to another device (output). Examples of input/output devices include the following.</p> <ul style="list-style-type: none"> ▪ CD-RW drive and DVD-RW drive - Receives data from a computer (input), to copy onto a writable CD or DVD. Also, the drive sends data contained on a CD or DVD (output) to a computer. ▪ USB flash drive - Receives, or saves, data from a computer (input). Also, the drive sends data to a computer or another device (output). <p><small>Note: Drives such as a CD-ROM, DVD, floppy diskette drive, and USB flash drive are also considered storage devices.</small></p>

Input devices, Output devices, Interfaces
Input - Output Devices:
<ol style="list-style-type: none"> 1. Access Types Storage Devices <ol style="list-style-type: none"> 1. Sequential Access 2. Direct Access 2. Input Devices <ol style="list-style-type: none"> 1. Human Data Entry Devices 2. Source data Entry Devices 3. Optical Input Devices 3. Output Devices <ol style="list-style-type: none"> 1. Hard Copy Devices 2. Soft Copy Devices

Input devices, Output devices, Interfaces
Input - Output Devices:
<ol style="list-style-type: none"> 1. Access Types Storage Devices <ol style="list-style-type: none"> 1. Sequential Access <ol style="list-style-type: none"> 1) Magnetic Tape 2. Direct Access <ol style="list-style-type: none"> 1) Magnetic Disk 2) Floppy Disk 3) Hard Disk 4) ZIP Disk (Magneto-Optical Disk) 5) Optical Disk <ol style="list-style-type: none"> 1) CD-R, CD-R/W, DVD-R, DVD-R/W

Input devices, Output devices, Interfaces

Input - Output Devices:

1. Access Types Storage Devices

1. **Sequential Access** : Sequential access means the data is written or read in sequence one after another and can't go directly to the desired location without going through all preceding locations.

Example: Magnetic Tape

Devices that record and play back audio and video using magnetic tape are tape recorders and video tape recorders respectively. A device that stores computer data on magnetic tape is known as a tape drive.



Input devices, Output devices, Interfaces

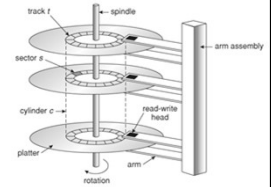
Input - Output Devices:

1. Access Types Storage Devices

2. **Direct Access** : Direct access devices are the ones in which any piece of data can be retrieved in a non-sequential manner by locating it using the data's address. The device is called random access because any data from any location can be read or written directly.

Example: Magnetic Disk

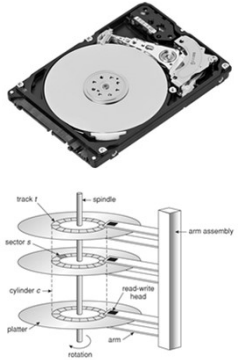
Data keeps in magnetized materials. Magnetic storage offers high storage capacity, reliability, and the capacity to directly accessing data. Data can be accessed randomly from magnetic disk.



Input devices, Output devices, Interfaces

Magnetic Disk:

- Data can be accessed randomly from magnetic disk.
- Magnetic disk holds more data in small place and attains faster data access.
- It is a thin, circular metal plate / platter coated with magnetic material such as iron oxide or ferrous oxide on the both side which can be magnetized.
- Data transfer rate higher than Tape system.
- Very large amount of data can be stored in a small space.
- Erased and reused many times.
- Cost is more expensive than tape system



Input devices, Output devices, Interfaces

2. Input Devices

1. Human Data Entry Devices

- 1) Keyboard
- 2) Pointing Device (Mouse)
- 3) Trackball
- 4) Joystick
- 5) Digitizing Tablet
- 6) Pick Devices (Light Pen, Touch Screen)

2. Source data Entry Devices

- 1) Audio Input Device
- 2) Video Input Device

Input devices, Output devices, Interfaces

2. Input Devices

3. Optical Input Devices

- 1) Scanner (Hand-held Scanner, Flat-bed Scanner)
- 2) OCR (Optical Character Recognition)
- 3) MICR (Magnetic Ink Character Recognition)
- 4) OMR (Optical Mark Recognition)
- 5) Barcode Reader

Input devices, Output devices, Interfaces

3. Output Devices

1. Hard Copy Devices

- 1) Printer
- 2) Plotter
- 3) Computer Output on Microfilm (Microfiche)

2. Soft Copy Devices

- 1) Monitor
- 2) Visual Display Terminal
- 3) Video Output (CRT, LCD, LED)
- 4) Audio Response

Input devices, Output devices, Interfaces

1. Human Data Entry Devices

Input devices that require data to be entered manually to the computer are identified as Human Data Entry Devices. The data may be entered by typing or keying in or by pointing a device to a particular location.

- 1) Keyboard
- 2) Pointing Device (Mouse)
- 3) Trackball
- 4) Joystick
- 5) Digitizing Tablet
- 6) Pick Devices (Light Pen, Touch Screen)
- 7) Video Input Device

Input devices, Output devices, Interfaces

2. Source Data Entry Devices

Source Data Entry Devices are used for audio input, video input and to enter the source document directly to the computer. Source data entry devices don't require data to be typed-in, keyed-in, or pointed to a particular location.

- 1) Audio Input Device
- 2) Video Input Device

Input devices, Output devices, Interfaces

3. Optical Input Devices

Optical or optical technology refers to anything that relates to light or vision, whether it be visible light or infrared light that performs a specific function. So optical input devices allow computer to use light as a source of input.

- 1) Scanner (Hand-held Scanner, Flat-bed Scanner)
- 2) OCR (Optical Character Recognition)
- 3) MICR (Magnetic Ink Character Recognition)
- 4) OMR (Optical Mark Recognition)
- 5) Barcode Reader

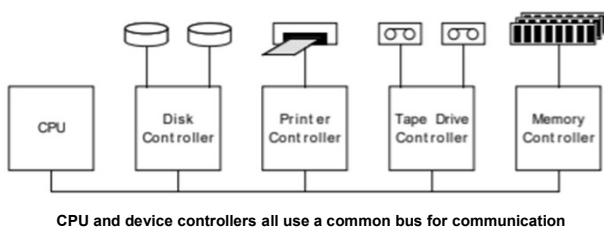
Input devices, Output devices, Interfaces

Input - Output Interface:

- Input Output Interface provides a method for transferring data between internal storage(RAM) and external I/O devices.
- Peripherals connected to a computer need special communication links for interfacing them with the CPU.
- The purpose of communication link is to resolve the differences that exist between the central computer and each peripheral.

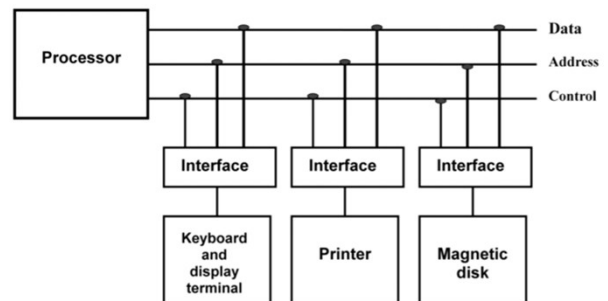
Input devices, Output devices, Interfaces

Input - Output Interface:



Input devices, Output devices, Interfaces

Input - Output Interface:



Input devices, Output devices, Interfaces

Input - Output Interface:

The Major Differences are:-

1. Peripherals are electromechanical and electromagnetic devices and CPU and memory are electronic devices. Therefore, a conversion of signal values may be needed.
2. The data transfer rate of peripherals is usually slower than the transfer rate of CPU and consequently, a synchronization mechanism may be needed.
3. Data codes and formats in the peripherals differ from the word format in the CPU and memory.
4. The operating modes of peripherals are different from each other and must be controlled so as not to disturb the operation of other peripherals connected to the CPU.

To Resolve these differences, computer systems include special hardware components between the CPU and Peripherals to supervise and synchronizes all input and out transfers

- These components are called Interface Units because they interface between the processor bus and the peripheral devices.

Input devices, Output devices, Interfaces

I/O(Input/Output) Port:

- An I/O port is a socket on a computer that a cable is plugged into.
- The port connects the CPU to a peripheral device via a hardware interface or to the network via a network interface. E.g. hardware interfaces, DisplayPort, HDMI and USB.
- A connection point that acts as interface between the computer and external devices like mouse, printer, modem etc.

Input devices, Output devices, Interfaces

I/O Port:

- Ports are of two types:

Internal Port: It connects the motherboard to internal devices like hard disk drive, CD drive etc.

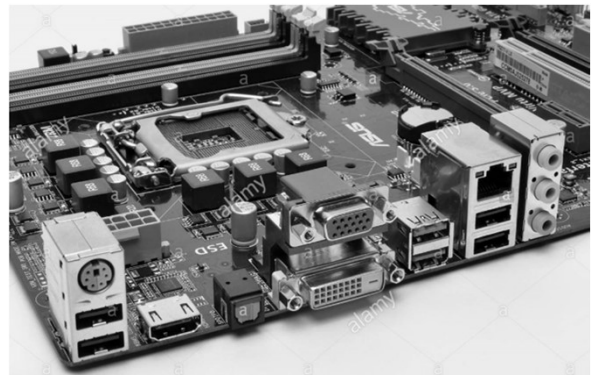
External Port: It connects the motherboard to external devices like modem, mouse, printer, flash drive etc.



- | | |
|-----------------------|--------------------------------------|
| 1. PS/2 keyboard port | 6. IEEE 1394 port |
| 2. PS/2 mouse port | 7. Ethernet ports |
| 3. Parallel port | 8. SPDIF coaxial digital audio port |
| 4. Serial port | 9. 1/8-inch mini-jack audio ports |
| 5. USB ports | 10. SPDIF optical digital audio port |

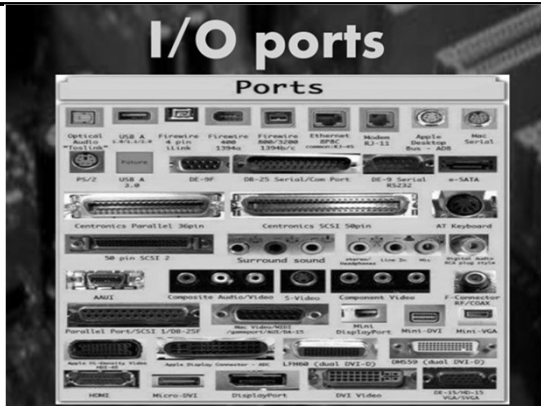
Input devices, Output devices, Interfaces

I/O Port:



Input devices, Output devices, Interfaces

I/O Port:



Working of I/O System

Working of I/O System:

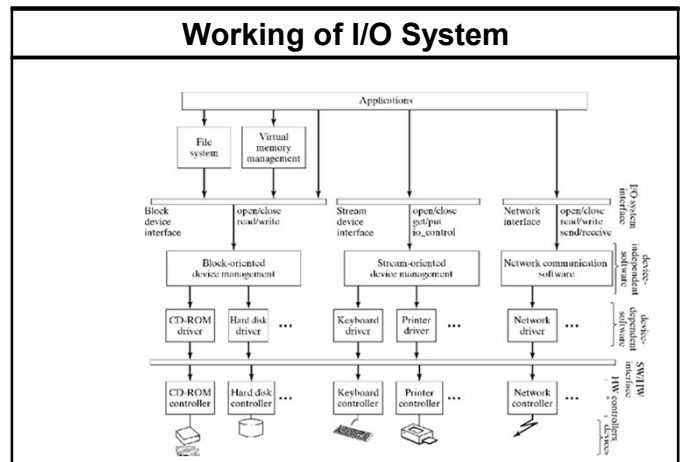
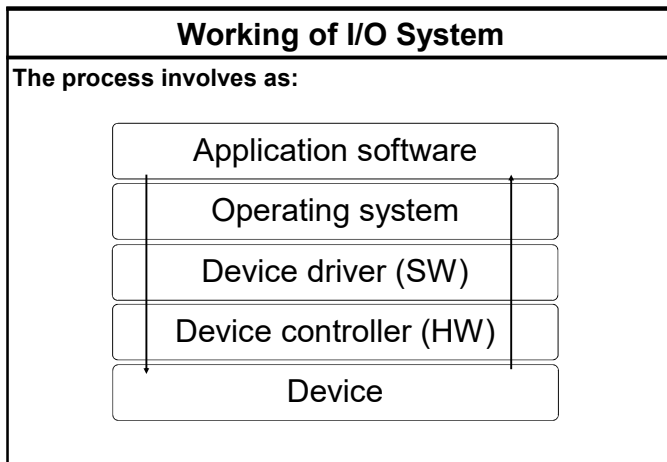
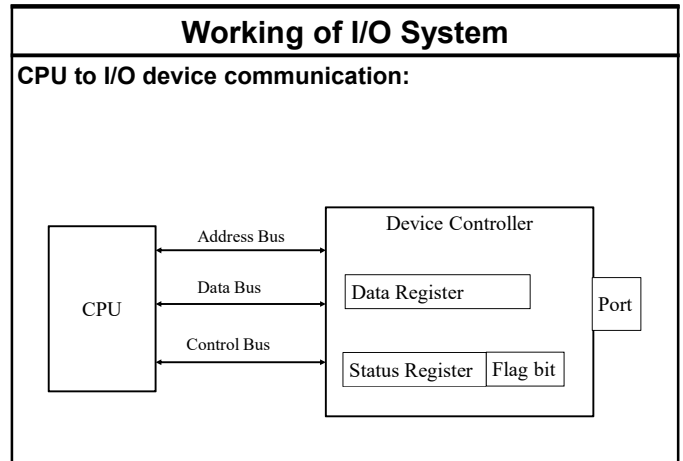
Working I/O system is the way to exchange data and instructions between a CPU and peripheral devices attached to it.

- Computer working with I/O system combines I/O hardware and I/O Software.
- I/O hardware includes ports, buses, device controller and I/O devices.
- I/O software is the device driver that may be embedded with operating system or comes with each device.

Working of I/O System

The process involves as:

- > **Application sw:** Issue command and exchanging data from Application SW through OS.
- > **Operating system:** Receive request from application sw and send the request to the device driver.
- > **Device Driver:** Provides correct commands to the device controller, interprets the controller register and transfers data to and from the device controller as required for the correct device operation.
- > **Device controller:** Operates on bus, a port and device. Controls the signal on the wires of port or bus.
- > **Device:** Device connected with wire or wireless and display or receive data to and from the connected device.



Working of I/O System

How CPU communicates with I/O devices:

Various methods to exchange data and instructions between a CPU and peripheral devices are

1. Memory-Mapped
2. Programmed I/O with Polling
3. Programmed I/O with Interrupts
4. Direct Memory Access (DMA)

Working of I/O System

How CPU communicates with I/O devices:

1. **Memory-Mapped**
 - > **Memory mapped IO** is one where the processor and the IO device share the same memory location(memory), i.e. the processor and IO devices are mapped using the memory address.
 - > **CPU** send the direct address (memory location) with data and send or receive the data from that memory location directly.

Working of I/O System

2. Programmed I/O with Polling

The CPU manually check if there are any I/O requests available periodically. If there isn't, it keeps executing its normal workflow. If there is, it handles the IO request from the peripherals.

CPU is responsible for

- moving every character to/from controller buffer
- detecting when I/O operation completed

Working of I/O System

2. Programmed I/O with Polling

Protocol to input a character/block:

Working of I/O System

3. Programmed I/O with Interrupts

➤ The CPU doesn't need to manually check for IO requests. When there is an I/O request available, the CPU is immediately notified using interrupts, and the request is immediately handled using an interrupt service routines.

- CPU is responsible for moving data, but
- Interrupt signal informs CPU when I/O operation completes

Protocol to **input** a character/block:

Working of I/O System

4. Direct Memory Access (DMA)

➤ DMA is a method allowing devices to access main memory without needing the CPU to explicitly handle the requests.

➤ When the CPU initiates data transfer from IO devices to main memory, the CPU instructs the DMA controller to handle this task. The CPU will then "forget" about this operation, and proceed with other tasks.

➤ When the DMA controller has completed the transfer, it will signal the CPU using an interrupt. The CPU will then "conclude" the task needed associated with the data transfer it initiated.

Working of I/O System

4. Direct Memory Access (DMA)

- CPU does not transfer data, only **initiates** operation
- **DMA controller transfers data** directly to/from main memory
- **Interrupts** when transfer completed

Input protocol: