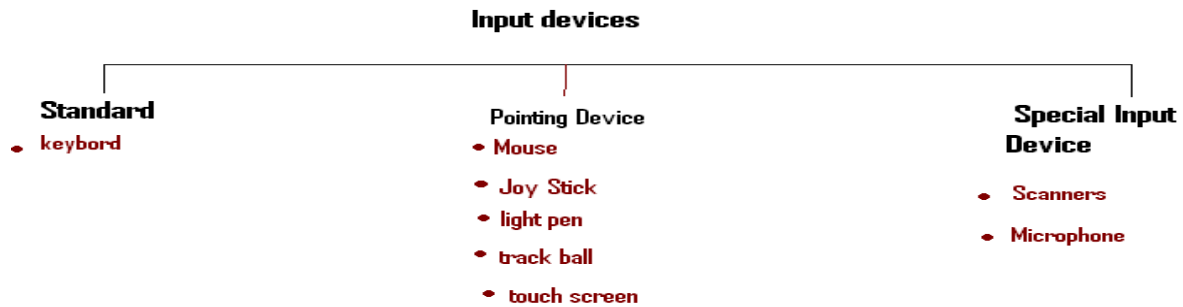


Unit -2(Input devices and Data storage)

Introduction to Input Devices

- All i/p device is an electromechanical devices that accept data from outside world & translates them into a form the computer interpret (i.e.binary)



- A wide range of input devices is available today that can be broadly classified into the following

➤ Standard input devices

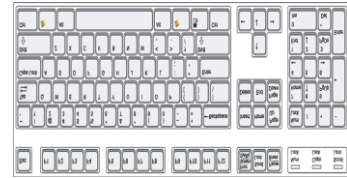
- Keyboard is the most commonly used input devices.
- They allows data entry into a computer system by pressing a set of keys.
- Keyboard devices can be broadly classified into two types::
 - 1) General Purpose .
 - 2) Special Purpose.

➤ General purpose keyboard

- General purpose keyboards are standard keyboards used with most computer systems.
- They are called general purpose because they have enough keys to make them useful for any type of application.
- They are design to meet the data entry requirements of a very wide range of computer users.
- The most popular general – purpose keyboards used today are the 101 – keys QWERTY keyboard.
- It was introduced and promoted by IBM for use with IBM PCs.
- The keys of a QWERTY keyboard are grouped into the following functional groups to make the keyboard easier and more comfortable to use ::

➤ **Key-Board**

- **Alphanumeric keys:-** The alphanumeric keys contain the number 0-9 and several special characters like ?,/,&,@,etc.
- **Numeric keys:-** The numeric keypad is a set of keys that looks like an adding machine with its ten digits (0-9) and mathematical operators (+,-,*,/,).
 - It is usually located on the right side of the keyboard.



Arrow keys:- Arrow keys are a set of four keys up, down, left and right.

- They are also called “cursor – control” or “cursor – movement” keys.

Special function key:- The keyboard also has a set of special function keys.

- Some of the most important keys are Enter, Shift, Ctrl, Alt, Backspace, Tab, Caps Lock , Num Lock, Home, End, Delete, Page Up , Page Down, Insert, Escape, Spacebar, Print screen, etc.

Other function key:- The other function keys are known as user – programmable function keys they are contains F1, F2, F3 and so on.

➤ **Special purpose keyboard**

- Special purpose keyboard have special function for faster data entry & rapid interaction with computer.
- For example, instead of typing the name and price of a purchased item.
 - Like Veg. Pizza, the operator need only press the key labeled “Veg. Pizza” and the system automatically prints the name and price of the item from an internally store database.
 - This application requires a special purpose keyboard for rapid data entry and faster operation.



Advantages

- Reliable for data input of text and numbers.
- Usually supplied with a computer so no additional cost.
- Specialized keyboards are available.

Dis-Advantage

- Users may be slow for not very accurate typists.
- Slow for accessing menus etc. and difficult to use if you want to move objects around the screen.
- Difficult for people unable to use keyboards through paralysis or muscular disorder.

Pointing Devices:

Mouse:-

- It is a small hand held device which fit into the user palm.
- It rolls on small bearing and has one or more button on top.
- When a user rolls the mouse across a flat surface such as on top of the table cursor moves on the side where mouse moves.
- Cursor has variety of symbols such as an arrow, pointing finger, etc.



Techniques of mouse

1. Point:-

- To point the menu item on top of the menu for selecting it using left mouse button.

2. Click:-

- To press and release mouse once to select the menu item using left key of mouse.
- To press and release once to call the pop up option menu using right key of mouse
- Usually depends on the software where the right click is used.

3. Double – click:-

- Using left key of mouse to press and release left button 2 times rapid to execute the selected icon.
- Using right key it depend on the software where the double right click is used.

4. Simultaneous – click:-

- To simultaneous – click means to press and release both the left and right mouse buttons simultaneously.
- It is used by some software packages to give added functionality to the mouse.

5. Drag:-

- Press and hold the left button. For example,
 - 1) To change the location or position of the icon.
 - 2) To draw object in some software such as Paint.
 - 3) To select the paragraph to copy or for selection to change style of font or size.

Types of Mouse

- There are 4 type of different categories of mouse

1. Mechanical and Optical Mouse:-

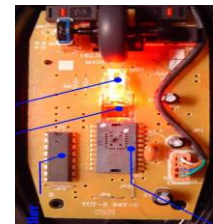
Mechanical mouse:-

- A mechanical mouse has a ball inside it.
- The ball rolls due to surface when the mouse is moved on a flat surface.
- On both sides of the ball at a 90-degree angle from each other there are two small wheels that spin to match the speed of the ball.
 - Each wheel of the mouse is connected to a sensor.
 - The mouse ball rolls when the mouse is moved, the sensors detect how much each wheel spins and send this information to the computer in the form of changes to the current position of the graphics cursor on the screen.
 - The mouse ball rolls when the mouse is moved, the sensors detect how much each wheel spins and send this information to the computer in the form of changes to the current position of the graphics cursor on the screen.



Optical mouse:-

- An optical mouse has no mechanical parts like the ball and wheels.
- It has a built-in photo-detector. This type of mouse comes with a special pad with gridlines printed on it.
- For moving the graphics cursor on the screen the mouse has to be moved on the special pad.



2. One, Two and Three Buttons Mouse:-

- A mouse can have one, two or three buttons.
- Programs are designed to use only a single button.
- In two or three button mouse, the leftmost button is the main button that allows most mouse operations because most people are right-handed and use their right-index finger to click the main button.

3. Serial and Bus mouse:-

- A serial mouse is one, which is designed to plug into a serial port.
- This type of mouse does not require a special electronic card for connecting the mouse to the computer system.
- A bus mouse is one that requires a special electronic card that provides a special port just for the mouse for connecting to the computer system.
- The special electronic card is fitted into one of the expansion slot inside the computer.
- A bus mouse occupies one of the expansion slot where a serial mouse does not need any expansion slot.

4. Wired and Cordless Mouse:-

- A wired mouse connected to the computer system with a small card.
- On the other hand, a cordless mouse is not connected to the computer system.
- It communicates with the computer system with the help of a special controller that operates by transmitting a low-intensity radio or infrared signal.
- A cordless mouse is more expensive than a wired mouse, it allows easier movements of the mouse

Uses:

- Movement - controlling a screen pointer
- Buttons - selecting items / menus etc.

Advantages:

- Ideal for use with desktop computers.

- Usually supplied with a computer so no additional cost.
- All computer users tend to be familiar with using them.

Disadvantages:

- They need a flat space close to the computer.
- The mouse cannot easily be used with laptop, notebook or palmtop computers. (These need a tracker ball or a touch sensitive pad called a **touch pad**).

+ Track Ball

- It is another pointing device.
- It uses the spherical ball which is rolled by the palm of the hand.
- The spherical ball is moved on top from thumb or finger and relative the cursor moves in screen.
- It does not require much space to use it and it can be placed on any type of surface.



Advantages:

- Ideal for use where flat space close to the computer is limited.
- Can be useful with laptops as they can be built into the computer keyboard or clipped on.

Disadvantages:

- Not supplied as standard so an additional cost and users have to learn how to use them.

+ Glide Pad

- A touch-sensitive pad about 2 x 2 that will track the touch of a finger.
- It is not a pressure sensor, so there is no need to press down, only to touch.
- This device acts like a mouse for pointing, and you can tap quickly on the pad to mimic a click

+ Joystick

- A lever that moves in all directions and controls the movement of a pointer or some other display symbol.
- A joystick is similar to a mouse, except that with a mouse the cursor stops moving as soon as you stop moving the mouse.
- With a joystick, the pointer continues moving in the direction the joystick is pointing.
 - To stop the pointer, you must return the joystick to its upright position.
 - Most joysticks include two buttons called triggers.



+ Light Pen

- It is called light pen, because its construction is similar to a pen and senses light.
- Construction of light pen is very simple. It has a photo cell which senses light of screen and converts into electrical signal.
- Using of light pen screen is refreshed every time which sense the change in light i.e. change in brightness of the screen.
 - When the light is sensed the corresponding information is generated and the position of the light pen is located. It can be used to draw object , point ,etc
 - Light pen does not have any tracking hardware to make use of light pen as a 'position' device a tracking program must be loaded in computer.



+ Touch Screen

- A touch screen is an input device that allows users to operate a PC by simply touching the display screen.
 - Touch screen is designed by different technologies
- 1) **By use of the optical sensor:-** optical sensor can sense the touch of the user when input is made with the finger.
 - 2) **Pressure sensitive monitors:-** which has sensor to measure the weight of monitor when user touches the screen the weight and force information is transferred to sensor and the sensor allow the device to detect the touch location. Some time user need to supply force on the screen to select the menu.
 - 3) **The display screen:-** It has a sensitive glass overlay placed on it and we could give the desired input by touching it.
 - A touch screen is based on CRT (Cathode Ray Tube) technology, that accepts direct onscreen input.
 - The ability for direct onscreen input is facilitated by an external (light pen) or an internal device (touch overlay and controller)

Main touch screen components:

- Touch sensor
- Controller
- Software driver

TOUCH SENSOR

- A touch screen sensor is a clear glass panel with a touch responsive surface which is placed over a display screen so that the responsive area of the panel covers the viewable area of the display screen.
- The sensor generally has an electrical current or signal going through it and touching the screen causes a voltage or signal change. This voltage change is used to determine the location of the touch to the screen



CONTROLLER

- The controller is a small PC card that connects between the touch sensor and the PC. It takes information from the touch sensor and translates it into information that PC can understand.



SOFTWARE DRIVER

- The driver is software that allows the touch screen and computer to work together. It tells the operating system how to interpret the touch event information that is sent from the controller.
- Most touch screen drivers today are a mouse-emulation type driver. This makes touching the screen the same as clicking your mouse at the same location on the screen.

Use of Touch Screen

- **Public Information Displays:::**
Tourism displays, Trade show display
- **Customer Self-Services:::**
Stores, Restaurants, ATMs, Airline ticket terminals and Transportation hubs.
- **More uses...**
Computerized gaming, Student Registration systems, Multimedia softwares, scientific applications etc.
- **Information counters:**

For public counter such as in bus stands, railways station, some museums, airport, departmental store, malls for the location of goods, rest room, to show way to customer and for attraction in shopping mall

Other Touch screen Technology

- Resistive touch screen
- Capacitive touch screen
- Infrared touch screen
- Surface acoustic wave (SAW) touch screen

1. Resistive Touch screen

- Resistive Touch screens consist of a glass or acrylic panel that is coated with electrically conductive and resistive layers made with Indium Tin Oxide (ITO).
- The thin layers are separated by invisible spacers.

➤ Characteristics of Resistive Touch screen

1. Cost effective solutions
2. Activated by a stylus, a finger or gloved hand
3. Not affected by dirt, dust, water, or light
4. 75%~85% clarify
5. resistive layers can be damaged by a very sharp object

2. Capacitive Touch screen

- Capacitive touch screen describe a two parts
 1. Projected – capacitive touch screen
 2. Surface – capacitive touch screen

❖ Projected – capacitive touch screen:-

- Projected capacitive touch screens have front and back protective glass providing optical and strength enhancement options.
- Its middle layer consists of a laminated sensor grid of micro-fine wires, and optical enhancement options.
- During a touch, capacitance forms between the finger and the sensor grid. The embedded serial controller in the touch screen calculates touch location coordinates and transmits them to the computer for processing.

❖ Surface – capacitive touch screen:-

- Surface capacitive technology consists of a conductive coating on a glass panel.
- Electrical rays around the panel's edge evenly distribute a low voltage across the conductive layer, creating a uniform electric field.
- A human body is an electric conductor, so when you touch the screen with a finger, a slight amount of current is drawn, creating a voltage drop.

➤ Characteristics of Capacitive touch screen

1. Faster and more responsive.
2. Superior optical clarity, brighter display and less surface reflection.
3. Must be touched by finger, will not work with any non-conductive input

3. Infrared touch screen

- Infrared (IR) technology relies on the interruption of an IR light grid in front of the display screen.
- The touch frame contains a row of IR-light emitting diode (LEDs) and photo transistors, each mounted on two opposite sides to create a grid of invisible infrared light.

- The IR controller sequentially pulses the LEDs to create a grid of IR light beams.
- When a stylus, such as a finger, enters the grid, it obstructs the beams.
- One or more photo transistors from each axis detect the absence of light and transmit a signal that identifies the x and y coordinates.

➤ **Characteristics of Infrared touch screen**

1. Clear as glass, improves reading ability.
2. Most durable surface.

4. **Surface Acoustic Wave (SAW) Touch Screen**

- Surface waves are readily absorbed when a soft object such as a fingertip touches the substrate.
- The touch screen controller sends an electrical signal to the transmitting transducer, which converts the signal into ultrasonic waves within the glass.
- When you touch the screen, you absorb a portion of the wave traveling across it.
- The received signal is then compared to the stored digital map, the change recognized, and a coordinate calculate.

➤ **Characteristics of SAW touch screen**

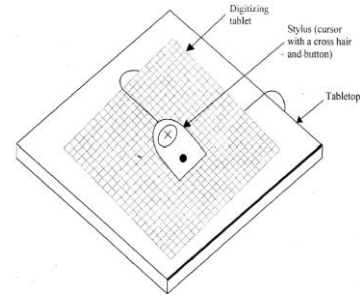
1. Durable glass construction
 2. High optical clarity
 3. Activated by a finger, gloved hand or soft tip
 4. Not completely sealable, can be affected by large amounts of dirt, dust, and / or water in the environment.
- Finally though the touch screen technology contains some limitations it's very user friendly, fast, accurate, easy for the use & fun.
 - It has been widely accepted and now by just modifying a little it can replace the mouse and key board completely in near future.

Graphics tablet

- A graphics tablet (also digitizer, digitizing tablet, graphics pad, drawing tablet or pen tablet) is a computer input device that enables a user to hand-draw images and graphics, similar to the way a person draws images with a pencil and paper.
- These tablets may also be used to capture data or handwritten signatures.
- It can also be used to trace an image from a piece of paper which is taped or otherwise secured to the surface.
- Capturing data in this way, either by tracing or entering the corners of linear poly-lines or shapes is called digitizing.
- A graphics tablet (also called pen pad or digitizer) consists of a flat surface upon which the user may "draw" or trace an image using an attached stylus, a pen-like drawing apparatus.
- The image generally does not appear on the tablet itself but, rather, is displayed on the computer monitor.
- Some tablets, however, come as a functioning secondary computer screen that you can interact with images directly by using the stylus.

Digitizer

- A digitizer is an input device, which is used for converting (digitizing) pictures, maps and drawings into digital form for storage -in computers.
- For example, the x and y coordinates of points in a drawing mat be stored in digital form.
- This enables re-creation of the drawing from the stored information, and easy incorporation of changes in the drawing, as and when required.



- A digitizer consists of a digitizing tablet (also known as graphics tablet) associated with a stylus.
- The digitizing tablet is a flat surface, which contains hundreds of fine copper wires forming a grid.
- Each copper wire receives electric pulses. The digitizing tablet can be spread over a working table, and is connected to a computer.
- The stylus is like a pen, or a lens-like cursor with a cross hair and button.
- The stylus is connected to the tablet, and can be pressed down at a point on the tablet to input the (x, y) coordinates of the point.
- When the stylus is moved on the tablet, the cursor on the computer's screen moves simultaneously to a corresponding position on the screen to provide visual feedback to the operator.
- Digitizers are commonly used in the area of Computer Aided Design (CAD) by architects and engineers to design cars, buildings, medical devices, robots, mechanical parts, etc.
- They are also used in the area of Geographical Information System (GIS) for digitizing of maps, which are available in paper form.

Microphone

- This is used for the input of sound which is then digitized by the computer.
- The digital audio can be saved for playback later on.
- The digital audio can also be used with voice-recognition software to control hardware, navigate a menu or input text into a word processor.
- Voice recognition can also be used in security systems.

Advantages:

- Voice recognition software can be used to convert your voice into text or to control menu options on a phone system.

Disadvantages:

- Stored audio files can take up a lot of memory.
- Voice commands can be difficult to recognize by the software.

Digital camera

- These are used to take photographs like a normal camera but produce digital images instead of using film.
- The light passing through the lens is digitized by special light sensitive sensors.
- The image is stored on memory chips in the camera and can then be transferred to a computer.
- The resolution of such cameras is increasing rapidly and professional models have become standard in photo-journalism.
- Images are usually compressed as jpeg's to save memory.
- Removable memory card Advanced models have removable memory cards to increase the camera's storage capacity.
- Images can be transferred to a computer by cables or memory card readers.

POS (Point Of Sale)

- A point-of-sale display (POS) is a specialized form of sales promotion that is found near, on, or next to a checkout counter (the "point of sale").
- They are intended to draw the customers' attention to products, which may be new products, or on special offer, and are also used to promote special events, e.g. seasonal or holiday-time sales.
- POS displays can include shelf edging, dummy packs, display packs, display stands, mobiles, posters, and banners.
- POS can also refer to systems used to record transactions between the customer and the commerce.

Computer terminal

- A computer terminal is an electronic or electromechanical hardware device that is used for entering data into, and displaying data from, a computer or a computing system.
- Early terminals were inexpensive devices but very slow compared to punched cards or paper tape for input, but as the technology improved and video displays were introduced, terminals pushed these older forms of interaction from the industry.
- A related development was timesharing systems, which evolved in parallel and made up for any inefficiencies of the user's typing ability with the ability to support multiple users on the same machine, each at their own terminal.
- The function of a terminal is confined to display and input of data; a device with significant local programmable data processing capability may be called a "smart terminal" or fat client.
- A terminal that depends on the host computer for its processing power is called a dumb terminal or thin client.
- A personal computer can run software that emulates the function of a terminal, sometimes allowing concurrent use of local programs and access to a distant terminal host system.

Special input devices :

Scanner:

- A scanner is an input device that translates paper documents into an electronic format that can be stored in a computer.
- The input documents may be typed text, pictures, graphics or even handwritten material.
 - The scanner treats the document as if it is drawn on graph sheet.
 - An intersection of horizontal & vertical line of a graph is called grid point.
 - If there is dark spot at the grid point it is represented by '1' otherwise '0'
- This representation is called bit map representation of image.
- Each bit in the representation of image is called "Pixel".
- Scanner having 300 to 600 grid points per inch is common.
- Scanners come in various shapes and sizes.



The types of scanners are:

1. Flat Bed Scanner
2. Hand Held scanner
3. Optical Scanner
 - i. Optical Mark Reader
 - ii. Optical Char Reader
 - iii. Optical Barcode Reader
 - iv. Magnetic Ink Character Recognition

1. Flat Bed Scanners

- A Flatbed scanner is usually composed of glass plate which you can lid documents to be scanned.
- Flatbed scanners are effectively useful to scan documents.
- The document to be scanned is placed upside down.
- The light source is situated below the glass plate and move horizontally from left to right when activated.
 - After scanning one line it moves to the next line to scan and this process continue.
 - It takes about 20 seconds to scan a document of size 21 cm X 28 cm.



2. Hand-held Scanner

- Hand-held scanner scan a document at a time a scanner is slowly dragged from one end of the document to its other end with its light on.
 - The scanner has to be dragged very steadily and carefully over the document; otherwise the conversion of the document into its equivalent bit map will not be correct.
 - They are usually used to read the barcodes & text in libraries and departmental stores.
 - It contains the set of LED. It is cheaper than flatbed scanner.



3. Optical Scanner

I) Optical Mark Readers (OMR)

- These scanners are capable of recognizing a pre specified type of mark made by pencil or pen.
- The use of OMR is not limited to the grading of objective tests.
- But it is useful to any input data that is of a choice or selection nature can be recorded for OMR input.
- OMR Software is a computer software application that makes OMR possible using a desktop computer.

Advantages:

- Very cheap
- Checking of papers made fast, accurate and without corruption.

Disadvantages:

- Can't read character
- Erasing or cancellation not possible
- The main disadvantage is need for good quality expensive paper.

II) Optical Character Readers (OCR)

- These devices are capable of detecting alphabetic and numeric characters printed on paper.
- An OCR device will transform the hand written text into the text in the computer.
- Some advanced OCR systems have the ability to recognize graphics and charts.
- If the characters are typewritten, they must be typed using a special type font called an OCR font.
- The standard fonts used are OCR-A (American standard) and OCR- B (European standard).
- Some OCR devices can also accept computer print-out and complete pages of typed text.

Advantages:

- Speed up data input.
- OCR devices can now accept a wide range of fonts, using ordinary (simple) inks.

Disadvantages:

- OCR devices are expensive and so used only for large- volume processing applications.
- Characters can be scanned properly only if they are standard size.
- Roughly handled and dusty papers cannot be scanned with accuracy.

III) Optical Barcode Reader (OBR)

- As the name suggests, an Optical Barcode Reader is used to read printed barcodes.
- Bar codes represent alphanumeric data by a combination of adjacent vertical lines by varying their width and the spacing between them.
- A barcode reader uses a laser – beam scanning technology.
- Different barcodes having different patterns of bars reflect the beam in different ways, which is sensed by a light – sensitive detector.
- It is a type of hand held scanners.

**IV) Magnetic Ink Character Recognition (MICR)**

- It is a character recognition technology mainly used in banking sector.
- It allows the computers to read information like account numbers from printed documents.
- In MICR, the characters are printed on documents using special magnetic ink.
- These characters when passed through the MICR device are identified by their magnetic field.

**Advantages:**

- Even roughly handled, folded, smeared can still be read with a high degree of accuracy.
- Speed up data input for the banking industry because check can be directly fed into the input device.

Disadvantages:

- No alphabets can be used.
- Special ink is required, hence expensive.

DATA STORAGE

➤ Introduction

- Also referred as Secondary Memory consists of devices that allow more permanent storage of data; i.e. they are non-volatile.
- It is usually much higher in capacity than main memory. However, they are much slower than main memory.
- Magnetic Disk (Hard Disk), Floppy Disk, Optical Disks are the examples of secondary storage devices. (will be discussed later) Secondary Storage Devices are also called as Secondary Memory, Auxiliary Devices.
- They are used to store the data permanent on the media which is used to store the data.

(1) Magnetic Disk Storage

- Magnetic disk drives are comprised of one or more circular rotating disks coated with magnetic material that is used for the recording of data.
- Data is stored and retrieved from the disk using a conducting coil called the Head. During a read / write, the head is stationary while the platter rotates beneath it.
- Data are recorded into concentric rings known as Tracks. A track is sub-divided into blocks called Sectors.

- Tracks on each surface of the disk are numbered. In a disk pack, all the similarly numbered tracks of each surface of each disk is known as a Cylinder.
- A block is the smallest unit of data that is transferred from the disk to the memory and vice versa. The first track (0 Track) of magnetic disk is called as FAT (File Allocation Table) which stores information about files.
- When accessing data from the magnetic disks, the read / write heads attached to the access arms will move to the correct track. The time taken to move the head to correct track is known as the Seek Time.

- Seek Time : Time taken by head to reach at desired track.
- Rotational Delay or Latency : Time taken by head to reach at desired data (sector) after reaching at particular track.

FAT (File Allocation Table) Track Sector

- Access Time : Seek Time + Rotational Delay.
- Response Time : Access Time + Data Transfer Time

Two common types of magnetic disks are Floppy disks and Hard disks :

(2) FLOPPY DISKS

- There are two types of floppy disks available :
 - 1) 3.5" (1.44 MB)
 - 2) 5.25" (1.2 MB)
- The most common floppy disk now in used is the 3.5" disk, also known as 1.44 MB floppy and microfloppy.
- 8" and 5.25" floppy disks were popular in the past but are superseded by the 3.5" disks.
- Floppies are made of plastic coated with magnetic oxide. The long lit is provided for the read / writes head to access the disk.
- A hub in the center is used for mounting the disk drive. A hole is used to sense index marking.

External Label Write Protect Notch Spindle Hole Index Hole
Read/Write Notch
Recording Windows with
Sliding Cover
5.25" (1.2 MB) 3.5" (1.44 MB)

(3) HARD DISKS

- Comprises at least one rigid disk protected by a strong, and usually air-tight, casing.
- The hard disk is usually a self-contained unit containing the disks, read / write head, access arms and servo motor enclosed within the casing, and the electronic circuit board controlling the disk operations attached to the external of the casing.
- The hard disk drive has become the most indispensable secondary storage device in micro-computers.
- It is fast and speeds of less than 10 (ms) milliseconds are achievable.
- Storage capacity is large and it is not uncommon for micro-computers.

(4) Magnetic Tape

- Magnetic tape allows large volumes of data to be stored economically.
- Magnetic tapes used to be available in large reels normally used with mainframe computers; however, magnetic tape cartridges are now available and is even used in micro-computer systems as backup devices.
- The tape is made of a plastic coated iron oxide. When the tape passes the tape device's write head, data is recorded by magnetizing the iron oxide in different directions.

- When reading data, the iron oxide causes a current in the read head.
- **Access Arm Read / Write Head Cylinder Non-Recordable Surface Spindle**

Advantage

- Inexpensive
- Large storage capacity
- Data can be stored permanently
- Direct recording
- Reusable
- Used in Batch Processing Jobs

Disadvantage

- Serial Access
 - Updated can not be automatically written back at their original place.
 - On-line updation is time consuming
- Data can be recorded onto the tape as records. Gaps are found between records and are known as IRG (Inter Record Gaps).
 - These gaps exist to allow the tape device to accelerate to the correct speed before data is accessed.
 - Records are normally 'blocked' together and are separated by IBG (Inter Block Gaps), 'Factor' refers to the number of records per block.
 - Data stored in IRG make data transfer slow and inefficient use of tape

Other Storage Disk

- In this form of storage, a light source, usually laser, is used to etch data patterns onto the surface of the disk.
 - Normally, two laser light sources are used : a weak laser used to read data while a stronger laser is used to record data by burning pits under the surface of the disk. CD-ROM (Compact Disk – Read Only Memory) is a non-erasable backing store which can hold large amounts of data.
 - Large volume production is achieved by automated processes similar to that of audio compact disks.
 - Many of today's micro-computers come with CD-ROM readers and as a result, CDROM is popularly used for distribution of software, digitized graphic images as well as Multi-Media material.
 - WORM (Write Once Read Many) disk technology is inexpensive and allows users to store large amounts of data.
 - The data can be read time and again but, once the data is stored, it cannot be erased or changed.
 - Some WORM drives only allow one write operation (i.e. additional data cannot be recorded subsequently even if the disk capacity is not fully utilized). Other types of WORM drives allow data to be incrementally recorded.
- **DVD (Digital Video Disc)**
- DVD, also known as Digital Video Disc or Digital Versatile Disc, is an optical disc storage media format, and was invented and developed by Philips, Sony, Toshiba, and Time Warner in 1995.
 - Its main uses are video and data storage. DVDs are of the same dimensions as compact discs (CDs), but are capable of storing more than six times as much data.

- Variations of the term *DVD* often indicate the way data is stored on the discs: DVD-ROM (read only memory) has data that can only be read and not written; DVD-R and DVD+R (recordable) can record data only once, and then function as a DVD-ROM; DVD-RW (rewritable), DVD+RW, and DVD-RAM (random access memory) can all record and erase data multiple times DVD-Video and DVD-Audio discs refer to properly formatted and structured video and audio content, respectively. Other types of DVDs, including those with video content, may be referred to as DVD Data discs.

➤ **Blu-ray disk**

- The industry is set for yet another revolution with the introduction of Blu-ray Discs (BD) in 2006.
- With their high storage capacity, Blu-ray discs can hold and play back large quantities of high-definition video and audio, as well as photos, data and other digital content.
- A current, single-sided, standard DVD can hold 4.7 GB (gigabytes) of information.
- That's about the size of an average two-hour, standard-definition movie with a few extra features. But a high-definition movie, which has a much clearer image.
- Blu-ray is the next-generation digital video disc. It can record, store and play back high-definition video and digital audio, as well as computer data. The advantage to Blu-ray is the sheer amount of information it can hold:
 - A single-layer Blu-ray disc, which is roughly the same size as a DVD, can hold up to 27 GB of data -- that's more than two hours of high-definition video or about 13 hours of standard video.
 - A double-layer Blu-ray disc can store up to 50 GB, enough to hold about 4.5 hours of high definition video **or** more than 20 hours of standard video. And there are even plans in the works to develop a disc with twice that amount of storage.

➤ **zip drive**

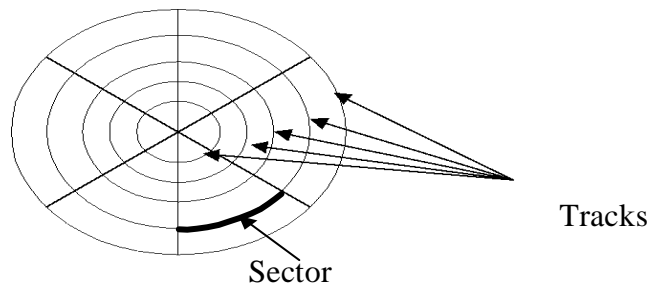
- A zip drive is a type of removal disk storage capable of holding a moderate amount of computer information.
- Although the zip drive was embraced by many computer users when it was introduced in 1994, it never replaced the 3.5-inch floppy disk. Rather, items such as rewritable digital versatile discs (DVDs), rewritable compact discs (CDs), and flash drives gained popularity and have virtually replaced the floppy disk. These storage devices have proven to be convenient and capable of holding large amounts of data. For this reason, the zip drive was never a popular device for data storage.
- The first zip drive system, introduced by Iomega, was capable of holding only 100 megabytes of information. This made the zip drive, which cost just under 200 US dollars (USD), an instant success, as people used it to store files that were too large to be placed on a floppy disk.
- The zip drive was later beefed up to hold 250 megabytes, and ultimately 750 megabytes of information. At the same time, Iomega improved upon the zip drive's ability to transfer data.
- The price for the 100 megabyte zip drive steadily fell as competition increased when other companies began offering their own versions. From 1999 to 2003, however, zip drive sales began to plummet.
- This was largely due to the decreasing costs of DVD±RW and CD-R. In addition, Universal Serial Bus (USB) flash drives with much larger capacities were introduced. Nonetheless, some computer users still prefer the zip drive because it is durable, reliable, and capable of transferring data quickly

➤ **Pen drive**

- A USB flash drive is an consists of a flash memory data storage device integrated with a USB (Universal Serial Bus). USB flash drives are typically removable and rewritable, and physically much smaller than a floppy disk. Most weigh less than 30 g.
- Storage capacities in 2010 can be as large as 256 GB with steady improvements in size and price per capacity expected.
- Some allow 1 million write or erase cycles and have a 10-year data retention cycle. USB flash drives are often used for the same purposes as floppy disks were.
- They are smaller, faster, have thousands of times more capacity, and are more durable and reliable because of their lack of moving parts.
- A flash drive consists of a small printed circuit board carrying the circuit elements and a USB connector, insulated electrically and protected inside a plastic, metal, or rubberized case which can be carried in a pocket or on a key chain, for example.
- The USB connector may be protected by a removable cap or by retracting into the body of the drive, although it is not likely to be damaged if unprotected.

- 1 USB connector
- 2 USB mass storage controller device
- 3 Test points
- 4 Flash memory chip
- 5 Crystal oscillator
- 6 LED
- 7 Write-protect switch (Optional)
- 8 Space for second flash memory chip

Storage Mechanism of Magnetic Storage Devices



Disk contains concentric Tracks

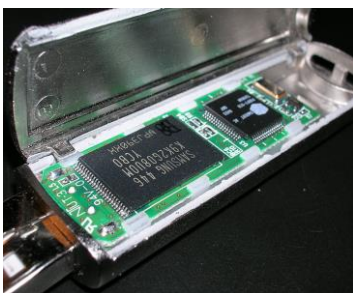
Tracks divided into Sectors A Sector is the smallest addressable unit in a disk

➤ **Flash memory**

- Flash memory is an electronic (solid-state) non-volatile computer storage medium that can be electrically erased and reprogrammed.
- Toshiba developed flash memory from EEPROM (electrically erasable programmable read-only memory) in the early 1980s and introduced it to the market in 1984. The two main types of flash memory are named after the NAND and NOR logic gates.
- The individual flash memory cells exhibit internal characteristics similar to those of the corresponding gates.
- Whereas EPROMs had to be completely erased before being rewritten, NAND-type flash memory may be written and read in blocks (or pages) which are generally much smaller than the entire device.

- NOR-type flash allows a single machine word (byte) to be written—to an erased location—or read independently.
- The NAND type operates primarily in memory cards, USB flash drives, solid-state drives (those produced in 2009 or later), and similar products, for general storage and transfer of data.
- NAND or NOR flash memory is also often used to store configuration data in numerous digital products, a task previously made possible by EEPROM or battery-powered static RAM. One key disadvantage of flash memory is that it can only endure a relatively small number of write cycles in a specific block

A USB flash drive. The chip on the left is the flash memory. The controller is on the right.



➤ Cloud Storage

- Cloud storage is a model of data storage in which the digital data is stored in logical pools, the physical storage spans multiple servers (and often locations), and the physical environment is typically owned and managed by a hosting company.
- These cloud storage providers are responsible for keeping the data available and accessible, and the physical environment protected and running.
- People and organizations buy or lease storage capacity from the providers to store user, organization, or application data.
- Cloud storage services may be accessed through a co-located cloud computer service, a web service application programming interface (API) or by applications that utilize the API, such as cloud desktop storage, a cloud storage gateway or Web-based content management systems.
- Cloud computing is believed to have been invented by Joseph Carl Robnett Licklider in the 1960s with his work on ARPANET to connect people and data from anywhere at any time.
- In 1983, CompuServe offered its consumer users 128k of disk space that could be used to store any files they chose to upload.
- In 1994, AT&T launched PersonaLink Services, an online platform for personal and business communication and entrepreneurship. The storage was one of the first to be all web-based, and referenced in their commercials as, "you can think of our electronic meeting place as the cloud." Amazon Web Services introduced their cloud storage service AWS S3 in 2006, and has gained widespread recognition and adoption as the storage supplier to popular services such as Smugmug, Dropbox, Synaptop and Pinterest.
- In 2005, Box (company) launched an online file sharing and personal cloud content management service for businesses.