INPUT OUTPUT DEVICE

- An **input device** is an electromechanical device that allows user to feed information, into the computer for analysis , storage and to give commands to the computer
- It capture information and translates it into a form that can be processed and used by other parts of the computer
- An **output device** converts machine-readable information into human-readable form (e.g graphical, alphanumeric, audio-visual form)

Importance of Input/Output Devices

- The processing of the data by the computer system can be viewed as a three-step process:
  - ❖ Step1 - Data input via an input device
  - ❖ Step2 – Processing of data
  - ❖ Step3 – Data output via an output device
- Input devices play a major role in the processing of any data via computer system because the output of the computer is always based on the given input
- The preparation of the computerized input is the initial step in the creation of useful output- this is done by input device
- The output must be supplied to the outside world , which is done through output devices

TYPES OF INPUT DEVICES

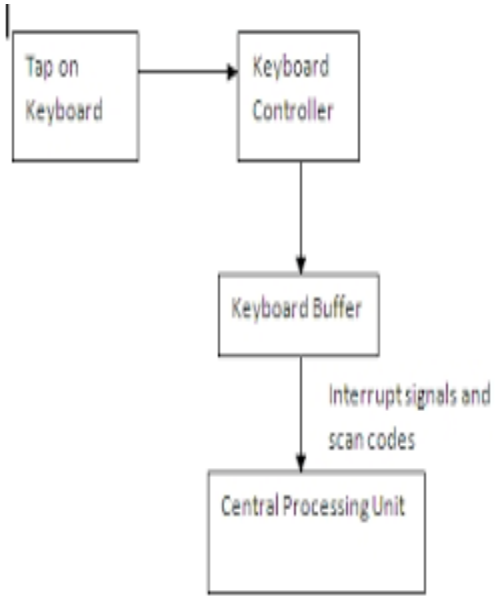
- Computer accepts input in two ways, either manually or directly
  - ❖ Manual Entry – user enters the data into computer by hand, example keyboard and mouse
  - ❖ Direct Entry – accomplished by using special direct data entry devices like a barcode reader
- Some commonly used input devices are keyboard, pointing devices like mouse and joystick, speech recognition, touch screen, digital camera and scanners

KEYBOARD

- A keyboard most common data entry device. Using keyboard , the user can type text and commands. The keyboard designed to resemble a regular typewriter with a few additional keys.
- The layout of keyboard comes in various styles , such as QWERTY, AZERTY and DVORAK. QWERTY is most commonly used English language keyboard layout
- Number of keys on a typical keyboard varies from 84 to 104
- Portable computers like Laptops quite often have custom keyboards that have slightly different key arrangements than a standard key board
- A keyboard is a easiest input device as it does not require any special skill
- However , using a keyboard for data entry may be a slow process because user has to manually type all the text.

How does the keyboard work?

- A keyboard is series of switches connected to a small keyboard microprocessor that monitors the state of each switch and initiates specific response to change in state
- When user presses a key , it causes change in the amount of current flowing through the circuit associated specifically with that key
- The keyboard microprocessor detects this change in current flow. By doing this , the processor can tell when a key has been pressed and when it is being released
- Depending upon which key's circuit carries a signal to the microprocessor , the processor generates the associative code, know as scan code, of the key and sends it to the operating system
- A copy of this code is also stored in the keyboard's memory (Keyboard Buffer)
- When operating system reads the code , it informs the same to the keyboard and the scan code stored in keyboard's memory is then erased



Pointing Devices

- A pointing device used to communicate with the computer by pointing to location on the monitor screen. Such device do not require keying of characters , instead user can move a cursor on the screen and perform move, click. Drag operations e.g ;mouse, trackball, joystick, light pen, touch screen, track board

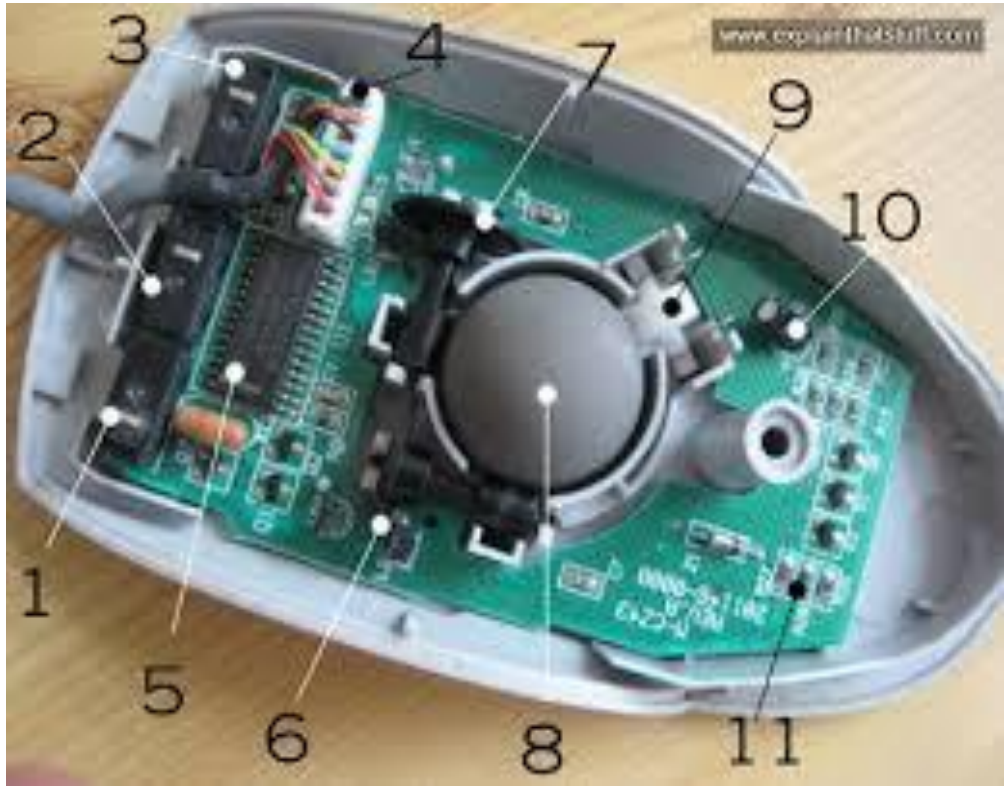
MOUSE

- A mouse is a small hand-held pointing device with a rubber ball embedded at its lower side and buttons on the top
- There are two types of mouse: Mechanical mouse and Optical mouse
- Mechanical mouse uses a rubber ball at the bottom surface, which rotates as mouse is moved along a flat surface, to move the cursor
- An optical mouse uses light beam instead of rotating ball to detect movement
- Optical mouse price is more than mechanical mouse , but it is accurate and often do not need mouse pad
- Mouse allows to create graphic elements on the screen such as lines, curves and freehand shapes. Since it is spontaneous device , it is easier and convenient to work as compare to the keyboard

How does mouse work?

Mechanical Mouse

- It has rubber ball at the bottom (no.8 in pic). When user moves the mouse along the flat surface , the ball rolls
- The distance, direction and speed of the ball's motion is tracked. This information used by the computer to position the mouse pointer on screen
- Inside the mouse there are three rollers (no.6,7, 9 in pic). One of them , which is mounted at a 45 degree angle (no.9 in pic) to other two is spring loaded. This roller is smallest of three. It is there simply to hold the ball against the other two rollers
- Other two rollers , those are large and different in colour , mounted to at 90 degree to each other
- One rollers measures how fast the ball is turning horizontally and the other measures how fast it is turning vertically. When the balls rolls, it turns these two rollers
- The rollers are connected to the axels* and axles are connected to a small sensor that measures how fast the axel is turning
- Both sets of information are passed to the electronics (processor, no.5 in pic) inside the mouse.
- This processor uses the information to determine how fast the mouse itself is moving and in what direction
- This information is passed to the computer via a mouse cord, where OS then moves the pointer accordingly



* Axles : rod or spindle either fixed or rotating passing through the centre of a wheel or group of wheels

How does mouse work?

Optical mouse

- It uses an infrared light and special mouse pad with fine grid lines to measure the rotation of the axle
- The axle in optical mouse is connected to a little photo interpreter wheel with a number of tiny holes in it
- In front of this wheel is a light source and on the other side of the wheel is a light metre
- As wheel turns, light flashes through the holes in the wheel
- By measuring how often these flashes occur, the light sensor can measure how fast the wheel is turning and sends the corresponding coordinates to the computer
- The computer moves cursor on the screen based on the coordinates received from the mouse
- This happens hundreds of times each second , making the cursor appear to move very smoothly

Pointing Device – TRACK Ball

- A trackball is another pointing device that resembles a ball nestled in a square cradle and serves as alternate to mouse (It looks like mouse is turned upside down)
- It is a static device (device can not be moved like mouse). It has a ball, which can be rotated by finger , thumb, palm in any direction accordingly cursor moves.
- Size of the ball can vary , shape of the device can also vary, commonly used device has ball , button and square in shape
- The cursor is activated when buttons on the device are pressed
- Since just fingers moving not entire arm , the user can get more precision and accuracy, so graphic designers and gamers choose track ball instead of mouse

- Since whole device is not moved , for moving cursor , trackball requires less space than mouse
- Track board has more buttons , so reduce use of keyboard
- The extra buttons in the track board can be programmed to the function we require
- While purchasing Trackboard does not come with computer, it has to be buy separately
- Before using them , user has to learn how to use them

Pointing Device – JOY STICK

- A **joystick** is a device that moves in all directions and controls the movement of the cursor
- The basic design consists of stick that is attached to a plastic base with a flexible rubber cover
- The plastic base houses a circuit board that sits beneath the stick. The electronic circuitry measures the movement of the stick from its central position and sends the information for processing
- A joystick also consists of buttons which can be programmed to indicate certain actions once a position on the screen has been selected using stick
- It offers three types of control : **digital, glide and direct. ‘**
- Digital control allows movement in a limited number of directions such as , up/down, left/right
- Glide and direct control allow movements in all directions (360 degree)
- Direct control joy stick has added ability to respond to the distance and speed with which user moves the stick
- A joystick is generally used to control the velocity of the screen cursor movement rather than its absolute position
- It is used for flight simulator, training simulators, CAD/CAM systems and for controlling industrial robots

LIGHT PEN

- A light pen / mouse pen is a hand-held electro-optical device which when touched monitor, will allow the computer to determine where on that screen the pen is aimed
- It facilitates drawing images and selects the objects on the screen by directly pointing to the objects
- It is pen like device, connected to machine by a cable.
- It has light sensitive diode, would sense the light coming from the screen. This causes photocell to respond by generating a electric pulse
- This electric response is transmitted to processor that identifies the position to which the light pen is pointing
- With movement of light pen over the screen, the lines or images are drawn

Advantages

- It provides full range of mouse capabilities without use of pad
- It is used directly on the screen , so does not require any special hand-eye coordinating skills
- Light pen is perfect for applications where desk space is limited and any situation where fast accurate input is desired
- A light pen is economically priced and requires little maintenance

Touch Screen

- A touch screen is special kind of input device that allows the direct selection of a menu item or the desired icon with the touch finger
- It is normally used when information has to be accessed with minimum effort, but it is not suitable for large amounts of the data.
- Typically it is used in information-providing systems , like hospitals, airlines and railway reservation counters, amusement park

- A basic touch screen has three main components: **A touch Sensor, A controller, and a Software driver**
- The **touch sensor** or panel is a clear glass panel with touch responsive surface. It is placed over the display screen, so that responsive area of the panel cowers the viewable area of the video screen
- The **controller** connects to the touch sensor and computer. It translate the information from touch sensor to computer (in computer understanding language)
- The **Software driver** is an update for the computer system that allows the touch screen and computer to work together

Track pad / Touchpad

- It is a stationary pointing device that works by sensing the movement of fingers across a small sensitive surface (1.5 to 2 inches) and translating them to the pointer movement on the screen
- It is generally used in Laptop, can also be used for PC through cord. Even it can be used in PDA – iPOD
- It also contains 2-3 buttons which work as mouse button
- Many track pads are strike sensitive, that is user can tap on the trackpad to perform operation like selecting an object, maximize, minimize window etc.

SPEECH RECOGNIZATION SYSTEM

- It is very interactive systems to communicate with computer
- The user can simple instruct the computer with help of microphone and speaking recognition software
- It is the technology by which spoken human words converted digital signals and signals are transferred into computer generated text or commands
- This system is speaker dependent , so they must be separately trained for each individuals
- It learns voice of the user , who speaks isolated words repeatedly. Then these voiced word recognizable in future
- It is very helpful for non-typists people with disabilities, business travellers who record the information for later transcription
- This system can be used to create text documents, email, browsing , and navigate the applications by voice command
- The user can communicated with the computer without keyboard and mouse
- It has relatively high accuracy but less reliability (example unable to differentiate between same sounding word : Sun/ Son)

Digital Camera

- Digital Camera stores images digitally rather than recording them on the films
- Once a picture has been taken , it can be transferred to computer system and then can be manipulated with image editing software and printed
- The big advantages of Digital camera is that making photos both inexpensive and fast as there is no film processing

Webcam

- Webcam (Web Camera) is portable video camera, which captures live videos or images that may be viewed in real time over a network or the Internet
- This camera either built in computer (laptop) or can be connected to the computer through USB. It is placed in top of the monitor where user is working
- Depending on capabilities and features , web cams are divided into two categories : **Streaming and Sanpshot**
- **Streaming** webcam captures moving images , this video immediately transferred to the recipient computer so, he/she no need to download it
- **Snapshot** webcam catches only still images (once in every 30 seconds) and refreshes it. It produces better quality images and is easier to configure than streaming webcam
- The most popular use of webcam is in video conferencing to provide a real time communications where people who are in different places can see each other
- Webcam can be used with messenger like Yahoo, Windows , where one can share the video while chatting
- It is also used in educational institutions for remote learning
- Webcams are cheap , compact and are easy to install and use. But major drawback is they produce only real-time images and can not be used unless attached with that PC

Scanners

- When some information (picture , text) available in paper , and need to be in computer , then scanner is used.
- **Scanner** is an input device that convert a document into a electronic format that can be stored on the disk. The electronic image can be edited, manipulated, combined and printed by using the image editing software.
- Scanners are also called optical scanners as they use light beam to scan the input data
- Scanner can store image in both grayscale and colour mode
- There are two types of Scanners : **hand-held scanners and flatbed scanners**

Hand-held Scanner: It consists of LED(Light Emitting Diode), placed over the document to be scanned

- It performs scanning of the document very slowly from top to bottom with its lights on
- All scanned documents are converted and stored as images
- While working scanner is dragged very steadily and carefully over the document at a constant speed without stopping or jerking to obtain best results
- If high accuracy not much important , the volume of the documents are low ,then hand-held scanner can be used
- The size of the scanner is very small , it comes in the various resolutions up to 800 dpi (dots per inch)
- Available in either greyscale or colour
- These devices read the data on price tag, shipping labels, inventory part no. etc

Scanners

Flatbed Scanner

- A flatbed scanner looks like photocopier machine, consists of a box containing a glass plate on its top and a lid that covers the glass plate
- The glass plate is used for placing the document to be scanner. The light beam placed below the glass plate and when it is activated, it moves horizontally from left to right.
- After scanning one line , the light beam moves in order to scan the next line and the procedure is repeated until all the lines are scanned
- Scanning an A4 documents takes about less than 20 seconds
- It can scan in black and white as well as colour images
- This scanner is large in size, more expensive than hand-held scanner, but produce better quality images as they employ better technology

Optical Character Recognition - OCR

- Scanner , scan the documents and store it in image form in disk. However if doc contains only text and it to be stored in the text form only then we have to use **OCR**
- The OCR software translate the bitmap image of text to the ASCII (American Standard Code for Information Interchange) codes that the computer can interpret as letters , numbers and special characters
- With OCR, data entry becomes easier , error free and less time consuming
- But it is very expensive and if document not typed properly , it will be difficult to OCR to identify the characters. Furthermore , except tab stops and paragraph marks, most document formatting lost during the scanning
- The scanned text file will require always spell check , proof reading and re-formatting to get the desired final result

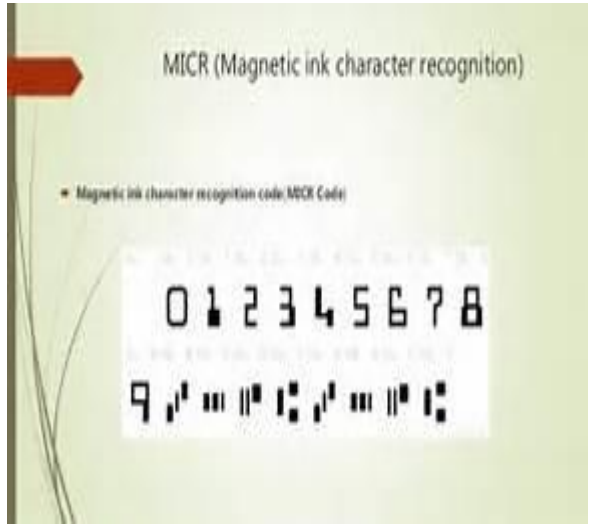
Optical Mark Recognition - OMR

- OMR is the process of detecting the presence of intended marked responses. It is done by special device known as Optical Mark Reader
- A mark register significantly less light than the surrounding paper
- In order to be detected by OMR , mark has to be positioned correctly on the paper and should be significantly darker than the surrounding paper
- OMR technology enables a high speed reading of large quantities of the data and transferring this data to a computer without using a keyboard
- Generally this technology is used to read objective type tests- answer sheet
- In this method special printed forms/documents are printed with boxes which can be marked with a dark pencil or ink
- These forms are then passed under a light source and presence of dark ink is transformed into electric pulses, which are transmitted to the computer
- OMR has better recognition rate than OCR because fewer mistakes are made by machines to read marks than in reading the hand written characters
- Usually OMR reader can maintain a throughput of 1500 to 10000 forms per hour

- But designing of documents for optical mark recognition is complicated and the OMR reader needs to be re-programmed for each new document design
- OMR readers are relatively slow because person putting marks on the documents must follow the instruction precisely
- Any folding or dirt on a form may prevent the form from being read correctly
- In addition it requires accurate alignment of printing on forms and needs paper of good quality

Magnetic-Ink Character Recognition - MICR

- On cheque at bottom , characters printed using special ink , which contains iron particles that can be magnetized
- To recognize these magnetic ink characters **, a Magnetic Ink Character reader (MICR)** is used
- It reads the character by examine their shapes in a matrix form and information is then passed onto the computer
- In banking industry MICR gives extra security. If a document has been forged, say counterfeit cheque produced using colour photocopying machine, the magnetic-ink line will either not respond to magnetic fields, or will produce an incorrect code when scanned using MICR
- The reading speed of MICR also very high , this method is efficient and time saving for data



BAR Code Reader

- A BAR code is a machine readable code in the form of pattern of parallel vertical lines of varying width
- It is commonly used for labelling goods in super markets and numbering books in libraries
- This code is sensed and read by **bar code reader** using reflection light
- The information recorded in bar code reader is then fed into the computer which recognizes the information from the thickness and spacing of bars
- Bar code is either hand-held or fixed mount

- **BAR code data** is just the reference numbers, which the computer use to look up associated record files, which contains descriptive information of the product . *i.e* record files contain information on product no, price , vendor name etc
- **Benefits of Bar Code reader :** 1.)Can record data 5 to 7 times faster than a skilled typist. 2.) A bar code data entry has an error rate of about 1 in 3 million. 3) Reduces cost in terms of reducing the labour, revenue loses resulting from data collection errors