

Why this chapter What is the use of the computer for us?The device driver provides correct commands to the controller, interprets the controller register, and transfers data to and from device controller registers as required for the correct device operation.

Input Devices Keyboard, Mouse, Digitizing Tablet, Track Ball, Joystick, TouchScreen, Light Pen, Speech Recognition System, Digital camera, Scanner, Magnetic Ink Character Recognition (MICR), Optical Character Recognition (OCR), Optical Mark Recognition (OMR), Barcode Reader

Output Devices Monitor, Visual Display Terminal, Printer, Plotter, Computer Output on Microfilm (COM), Video Output System, Audio Response System

Input- Output Devices Hard disk drive, Floppy disk drive, USB drive, CD drive, DVD drive

Table 4.1 I/O devices

4.3 INPUT DEVICES

Input devices allow users and other applications to input data into the computer, for processing.

Source data entry devices

- o Audio input--speech recognition
- o Video input--digital camera
- o Scanner--hand-held scanner, flat-bed scanner
- o Optical Scanner--OCR, OMR, MICR, barcode reader

The input is provided to the computer using an input device, and must be translated to a form that the computer can understand. Also in a portable computer, the PC Card connects to the PC Card slot on it. The I/O ports are the external interfaces that are used to connect input and output devices like printer, modem and joystick to the computer.

4.5.3.2 Optical Character Recognition (OCR)

OCR is a technique for the scanning of a printed page, translating it, and then using the OCR software to recognize the image as ASCII text that is editable. Plotters are mainly used for drawings in AUTOCAD (computer assisted drafting), Computer Aided Design (CAD) and Computer Aided Manufacturing (CAM) applications. In brief, the input unit accepts input data from the user via input device, transforms the input data in computer acceptable form using input interface for the input device and provides the transformed input data for processing. Touch screen are generally used in applications like Automated Teller Machine (ATM), public information computers like hospitals, airline reservation, railway reservation, supermarkets, etc. Other common optical input devices are magnetic ink character reader used for Magnetic Ink Character Recognition (MICR), optical mark reader used for Optical Mark Recognition (OMR), optical character reader for Optical Character Recognition (OCR) and Barcode Reader. The OMR reader scans the forms, detects the mark that is positioned correctly on the paper and is darker than the surrounding paper, and passes this information to the computer for processing by application software.

4.6.1.2 Plotter

A plotter is used for vector graphics output to draw graphs, maps, blueprints of ships, buildings, etc. In addition to the above ports, other ports also exist like Musical Instrument Digital Interface (MIDI) port to connect musical instruments like synthesizers and drum machines, PC expansion boards, and PC card and many more. In brief, the output unit accepts output data from computer via output device, transforms the output information to human readable form using the output interface of output device and provides the transformed output to user. In addition to the above devices, the input to a computer can also be provided from a storage device on the computer, another computer, or another piece of equipment, such as a musical instrument, thermometer or sensors

4.4 HUMAN DATA ENTRY DEVICES

Input devices that require data to be entered manually to the computer are identified as human data entry devices. Digitizing tablet is used for Computer Aided Design (CAD) for the design of buildings, automotive designs, and designing of maps, etc.

Working The tablet contains circuit that can detect the movement of pen on the tablet, convert the movements into digital signals and send the digital signal to

the computer. Scanners come with utility software that allow the stored scanned documents to be edited, manipulated and printed. The processed data, presented to the user via the output devices could be text, graphics, audio or video. In a drum plotter, pens mounted on the carriage are stationary and move only horizontally; for vertical movement, the drum on which the paper is fixed moves clockwise and anti-clockwise. The projector is mainly used to display visual output to a large gathering of people required for the purposes of teaching, training, meetings, conference presentations, etc.

4.1 INTRODUCTION

A computer interacts with the external environment via the input-output (I/O) devices attached to it. Input device is used for providing data and instructions to the computer. Moreover, it provides an easy way to select and choose commands from menus, dialog boxes, icons, etc. Right Click involves pressing the right button on mouse and releasing it. Right click displays a menu that contains options like cut, copy, paste, font, paragraph, etc.

4.4.2.4 Digitizing Tablet Features

It is an input device used primarily to input drawings, sketches, etc. Open source software like Audacity is used for recording and editing of audio files.

4.5.2 Video Input Device

Video input is provided to the computer using video camera and digital. Soft Copy Devices

- o Monitor
- o Visual Display Terminal
- o Video Output
- o Audio Response

The output device receives information from computer in a machine readable form. The speed of dot matrix printer lies between 200 and 600 characters per second (cps) and their resolution ranges from 72 to 360 dpi. Dot matrix printers are commonly used for printing in applications like payroll and accounting. Plotters draw continuous and accurate lines, in contrast to printers where a line is drawn as closely spaced dots. COM is suited for storing large amounts of data for manuals and archive records for long periods of time that have to be referenced occasionally. The number of colors displayed by a color monitor varies with the kind of color adapter attached to it--CGA, EGA, VGA, XGA and SVGA. Monitors may be Cathode Ray Tube (CRT) monitors that look like a television or Liquid Crystal Display (LCD) monitors that have a high resolution, flat screen, flat panel display. Irrespective of the kind of input data provided to a computer, all input devices must translate the input data into a form that is understandable by the computer, i.e., in machine readable form. The output data is provided through output devices like display screen, printer, plotter and speaker.

Human data entry devices

- o Keyboard
- o Pointing devices--mouse, trackball, joystick, digitizing tablet
- o Pick devices--light pen, touch screen

?A sound card (Figure 4.9 (i)) translates analog audio signals from microphone into digital codes that the computer can store and process. Some of the documents that are primarily scanned using hand-held scanners are price tags, label and ISBN number on books. The OCR software translates the array of dots into text that the computer can interpret as words and letters. To recognize the words and letters of text, the OCR software compares the pattern on the scanned image with the patterns stored inside the computer.

4.5.3.5 Barcode Reader

Barcodes are adjacent vertical lines of different width that are machine readable. Dot matrix printers can print alphanumeric characters, special characters, charts and graphs. Microfilm can be indexed to facilitate retrieving information from it. For reading images stored on microfilm, a microfilm reader is used.

4.6.2 Soft Copy Devices

The output obtained in an intangible form on a visual display, audio unit or video unit is called soft copy output. In addition to recording and playing the sound, the software allows editing of sound, like cutting, copy, amplification and creation of vibrant sound effects. The I/O devices are connected to the computer via the serial and parallel ports, Universal

Serial Bus (USB) port, Firewire port, etc. Normally, two to four USB ports are provided on a PC. USB allows different devices to be connected to the computer without requiring re-boot of the computer. After processing the input data, computer provides output to the user via the output device. The input data is provided through input devices, such as—keyboard, mouse, trackball and joystick. Input data can also be provided by scanning images, voice recording, video recording, etc. The keyboard controller stores the code of pressed key in keyboard buffer and informs the computer software that an action has happened on the keyboard. Due to a time gap between pressing of a key on keyboard and reading by the system software, keyboard buffer is designed to store many keystrokes together. Optical Mouse uses a Light Emitting Diode (LED) and a sensor to detect the movement of mouse. Joystick is mainly used to control the speed of the cursor and is thus popular in games involving speed like racing and flying games. It can be used for making telephone calls, for audio and video conferencing over Internet, to record voice, to create audio files and embed these files to be sent over e-mail, or, to translate spoken words into text, etc. Audio input can be recorded on an mp3 recorder and provided as an input to computer. Scanner accepts the source paper document, scans the document and translates it into a bitmap image to be stored on the computer. The optical character reader stores the scanned image as bitmap image which is a grid of dots. The text files generated via OCR can be stored in different formats. Hand-held barcode readers are generally used in departmental stores to read the labels, and in libraries to read labels on books.

4.6 OUTPUT DEVICES

Output devices provide output to the user, which is generated after processing the input data.

Hard Copy Devices

- o Printer
- o Plotter
- o Computer Output on Microfilm (microfiche)

Impact printers use the typewriter approach of physically striking a typeface against the paper and inked ribbon. Dot matrix printers, daisy wheel printers and drum printers are examples of impact printers. Dot matrix printers normally come in two sizes—80 column printer and 132 column printer. These printers are slow, can only print text (not graphics), and are costly in comparison to dot matrix printers. The laser printer can print 5–24 pages of text per minute and their resolution ranges from 400 to 1200 dpi. Laser printers are used in applications requiring high quality voluminous printing. COM is used for storing output in banking and insurance applications, medical X rays, etc. Visual output devices like computer monitor, visual display terminal, video system and audio response system are common soft copy output devices. The signals are sent to the speakers via the sound card that translates the digital sound back into analog signals. The audio response from the computer may be generated by synthesizing the input human speech to give audio output, or may be a result of a set of rules that are used to create artificial speech. Serial port is used to connect external modems, plotters, barcode reader, etc. The I/O hardware includes ports, buses and device controllers for different devices, and I/O devices. The input unit gets the data and programs from various input devices and makes them available for processing to other units of the computer. This processed data is converted to human readable form by the output interface of output device. Hard disk drive, floppy disk drive, optical disk drives are examples of I/O devices. Cursor is a vertical line, an underscore, blinking line, etc. The keyboard has five sections (1) Typing keys (1, 2, 3..., A, B, C...), (2) Numeric keypad (numeric keys on right side), (3) Function keys (F1, F2....

Working When a key is pressed, keyboard interacts with a keyboard controller and keyboard buffer. The computer software checks and reads the keyboard buffer and passes the code

of pressed character to the system software. Mouse, trackball, joystick and digitizing tablet are some of the common pointing devices. Mouse is used extensively, while working with graphics elements such as line, curve, shapes, etc. When the ball of mouse moves, the rollers sense the horizontal and vertical movement and sensors sense the speed of movement. Left Click or Click means pressing the left button of mouse and releasing it. Clicking is used to select a button, command or icon on the screen. Instead of moving the whole device to move the cursor on computer screen, trackball requires the ball to be rotated manually with a finger. Drawings can be made on the tablet using a pen, and is provided as input to computer, where, a location on the tablet corresponds to a specific location on the screen.

4.4.3.2 Touch Screen Features

It is an input device that accepts input when the user places a fingertip on the computer screen. In addition to the glass panel with sensors, it has a device driver, and a controller that translates the information captured by the glass panel sensors to a form that the computer can understand. Source data entry devices do not require data to be typed-in, keyed-in or pointed to a particular location. Sound card also translates back the digital sound into analog signals that can be sent to the speakers. They are generally used by people who have difficulty in typing, people with disabilities or by corporate world for dictation. The images are digitized and can be compressed and stored in the computer disk. A video capture card allows the user to connect video devices like camcorders to the computer. Computer vision has applications in areas like robotics and industrial processing. It is an optical input device and uses light as an input source to convert an image into an electronic form that can be stored on the computer. To edit the scanned text, you need OCR software.

4.5.3.3 Magnetic Ink Character Recognition (MICR)

MICR is used in banks to process large volumes of cheques. It is used for recognizing the magnetic encoding numbers printed at the bottom of a cheque. The numbers on the cheque are human readable, and are printed using an ink which contains iron particles. The optical mark reader detects the presence of mark by measuring the reflected light. The output could be on a paper or on a film in a tangible form, or, in an intangible form as audio, video and electronic form. Printer, plotter and microfiche are common hard copy output devices. Printers are generally used to print textual information, but nowadays printers also print graphical information. Drum printers are generally used for voluminous print outputs. Laser Printers provide highest quality of text and graphics printing. The paper is stationary and the pens mounted on the carriage move horizontally and vertically to draw lines.

4.6.1.3 Computer Output on Microfilm

A microfilm is in a fiche or roll format, and is used to record computer output directly from the computer tape or cartridge. The soft copy allows corrections to be made, can be stored, and, can be sent via E- to other users.

Dot Pitch

--the diagonal distance between two colored pixels on a display screen, and

3.4.6.2.2 Visual Display Terminal

A monitor and keyboard together are known as Visual Display Terminal (VDT).

4.6.2.4 Audio Response

A complete sound system consists of sound card, microphone, speaker and the appropriate software. Audio output device like speakers, headset or headphone is used for audio output sound from computer. Audio output is commonly used for customer service in airlines, banks, etc. Since data is transmitted serially as single bits, serial ports provide slow speed data transmission. USB also has the plug and play feature which allows devices ready to be run simply by plugging them to the USB port. Firewire (IEEE 1394) It is used to connect audio and video multimedia devices like video camera. Device Driver is software via which the operating system

communicates with the device controllers. The device drivers hide the differences among the different device controller and present a uniform interface to the operating system. The aim of this chapter is to introduce the different kinds of input and output devices. Different kinds of input and output devices are used for different kinds of input and output requirements. The input unit is responsible for providing input to the computer and the output unit is for receiving output from the computer. The transformation of the input data to machine readable form is done by the input interface of input device. The output unit gets the processed data from the computer and sends it to output devices to make them available to the user

of computer. The data input to a computer can be in the form of text, audio, video, etc. The data is entered manually by the user or with minimal user intervention. Input devices are classified as follows—

?The position of cursor indicates the location on monitor where the typed-in character will be displayed. The modern keyboards are QWERTY keyboard (Q, W, E, R, T, Y are the sequence of keys in top row of letters). on top side), (4) Control keys (cursor keys, ctrl, alt...), and (5) Special-purpose keys (Enter, shift, spacebar...).

Optical mouse requires an opaque flat surface underneath it. Optical mouse was introduced by Microsoft in 1999. Optical mouse is better than physical mouse as there is no moving part that can cause wear and tear, and dirt cannot get inside it. Working In a physical mouse, rollers and sensors are used to sense the direction and rate of movement of mouse. When an optical mouse is moved, a beam of light is reflected from its underside.

4.4.2.2 TrackBall Features Trackball is a device that is a variant of the mouse but has the functionality of mouse. The plastic cover contains the circuit that detects the movement of stick and sends the information to computer. Description Digitizing tablet consists of two parts—electronic tablet and pen. 4.4.3.1 Light Pen Features It is a light sensitive pen-like input device and is used to select objects directly on the computer screen. Working Touch screens have an infrared beam that criss-cross the surface of screen. Some touch screens have ultrasonic acoustic waves that cross the surface of screen.

4.5 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. Audio input devices like a microphone is used to input a person's voice into the computer. The audio input along with the software for voice recognition forms the speech recognition system or voice recognition system. The user can dictate the commands to the computer, instead of typing them. The

digital camera digitizes images, compresses them and stores them on a memory card like flash memory. Scanner is used to input data directly into the computer from the source document without copying and typing the data. The scanned documents are converted and stored as an image in the computer memory. The document to be scanned is placed on the glass top, which activates the light beam beneath the glass top and starts the scan from left to right. OCR uses optical character reader for recognition. Thus, you cannot edit the text that has been scanned. MICR uses magnetic ink character reader for character recognition. When a cheque is passed through Magnetic Ink Character Reader, the

magnetic field causes the read head to recognize the characters or numbers of cheque. 4.5.3.4 Optical Mark Recognition (OMR) OMR is used to detect marks on a paper. For this, it uses a beam of light that is reflected on the paper with marks, to capture presence and absence of marks. OMR is widely used to read answers of objective type tests, where the student marks an answer by darkening a particular circle using a pencil. Barcodes are read using reflective light by barcode readers. This information is input to the

computer which interprets the code using the spacing and thickness of bars. They enable faster service to the customer and are also used to determine the items being sold, number of each item sold or to retrieve the price of item. Output devices are classified as follows--

4.6.1 Hard Copy Devices

The output obtained in a tangible form on a paper or any surface is called hard copy output. The print quality (sharpness and clarity of print) of the printer is determined by the resolution of the printer. Resolution is measured in dots per inch (dpi). Printers with a high resolution (more dpi) provide better quality output. Printers are classified into two categories--impact printer and non-impact printer. They produce letter quality document which is better than a document printed by a dot matrix printer. Daisy wheel printers are used where high quality printing is needed and no graphics is needed. They use electro-static chemicals and ink-jet technologies. They produce high quality output and can be used for printing text and graphics both in black and white, and color. Ink-jet printers are commonly found in homes and offices. Plotters use pens of different colors (cyan, magenta, yellow and black) for drawing. Plotters are of two kinds--drum plotter and flatbed plotter. Monitors are available in various sizes like 14, 15, 17, 19 and 21 inches. Resolution of Screen--the number of pixels in horizontal and vertical direction. Nowadays, LCD monitors are generally used. A keyboard is used to input data and monitor is used to display the output from the computer. The dumb terminals do not have processing and programming capabilities. Smart terminals have built-in processing capability but do not have its own storage capacity. Printers and scanners are connected to ports on the backside of the computer. Application programs use an I/O device by issuing commands and exchanging data with the device driver. Operating system ----- Device Drivers ----- Device Controllers ----- Devices

But to do any of these things, we should be able to provide the data to the computer and also get the output from it. The input devices and output devices are used this purpose. The I/O devices that are attached, externally, to the computer machine are also called peripheral devices. In this chapter, we shall discuss different kinds of input devices and output devices.

4.2 INPUT-OUTPUT UNIT

An I/O unit is a component of computer. The I/O unit is composed of two parts--input unit and output unit. The processed data sent to the output device is in a machine understandable form. In addition to input devices and output devices, some devices function as both input and output devices. The I/O devices provide the input to computer as well as get output from computer. The I/O devices are used by both the input unit and the output unit. The translation is done by the input interface of the input device.

4.4.1 Keyboard Features

Keyboard is a common input device. For inputting the data, the user types the data using the keyboard. When the data is being typed, the display monitor displays the typed data. Standard keyboard contains 101 keys which are arranged in the same order as a typewriter.

4.4.2 Pointing Devices

Pointing devices are used for providing the input to computer by moving the device to point to a location on computer monitor. Operations like move, click and drag can be performed using the pointing devices. The mouse may also be used to position the cursor on screen, move an object by dragging, or select an object by clicking. It requires a smooth, dust free surface, such as a mouse pad, on which it is rolled. These pulses of light determine the direction and rate of movement. Double Click means pressing the left button of mouse twice successively, without moving the mouse, and then releasing the mouse. Drag and drop is used for moving folders, files and icons to new locations on the screen. Trackball is generally built in

laptops since there is no space for the mouse to move on the lap. Trackballs come in various sizes—small and big.

4.4.2.3 Joystick Features

Joystick is a device which is commonly used for playing video games. The direction of push of the stick and the amount of deflection determines the change in position and the change in speed, respectively.

4.4.3 Pick Devices

Pick devices are used for providing input to the computer by pointing to a location on the computer monitor.

Description and Working

The pen contains a photocell in a small tube. When a fingertip is touched on the screen, the beam is broken, and the location is recorded. When a fingertip is touched on the screen, the wave is interrupted, and the location is recorded. The recorded location is sent to the computer via the controller of touch screen, in a form that the computer can understand.

4.5.1 Audio Input Device

Audio input can be provided to the computer using human voice or speech. Audio input to the computer can be used for different purposes. Translating spoken words into text is also known as speech recognition or voice recognition. The computer has to be trained to recognize the voice of user using the speech patterns and pronunciation of words. The system thus adapts to the voice of user. Speech recognition systems are costly and difficult to develop. It is placed on the computer above the screen to capture the images of the user who is working on the computer. Digital camera works like video camera but can capture still images. The video files can be edited using software like VLC media player.

4.5.3 Optical Input Devices

Optical input devices allow computers to use light as a source of input. Scanner is an example of optical input device.

4.5.3.1 Scanner

Scanner is an input device that accepts paper document as an input. The input data to be scanned can be a picture, a text or a mark on a paper. The denser the bitmap, the higher is the resolution of the image. The quality of scan increases with the increase in resolution. Hand-held Scanners are portable and are placed over the document to be scanned. They consist of light emitting diodes. Hand-held scanners have to be moved at a constant speed over the document to be scanned, to get good quality scans. They are preferably used for low volume of documents, small pictures or photos. It is a box shaped machine similar to a photocopy machine and has a glass top and a lid that covers the glass. They are largely used to scan full page documents. The readers are generally used in banks to process the cheques. OMR uses an optical mark reader to read the marks. OMR is also used to read forms, questionnaires, order forms, etc. Barcode readers are fast and accurate. The received output is translated to a human understandable form. The translation is done using the output interface of output device. The hard copy can be stored permanently and is portable. The devices that generate hard copy output are called hard copy devices. Impact printers are low-cost printers useful for bulk printing. Dot Matrix Printers (Figure 4.17) print one character at a time. Some dot matrix printers can print in both directions – left to right and right to left. The speed of daisy wheel printers is about 100 cps. The print head of the printer is like a daisy flower, hence the name. Laser printers process and store the entire page before printing and are also known as page printers. The copy of the image on microfilm retains its original clarity. A screen is used for viewing the enlarged images. The devices that generate soft copy output are called soft copy devices. The monitor is provided along with the computer, to view the displayed output. A monochrome display monitor uses only one color to display text and color display monitor can display 256 colors at one time. The CGA monitor supports four colors and SVGA supports around 16,000,000 colors. An image on the monitor is created by a configuration of dots, also known as

pixels.Refresh Rate--the number of times per second the pixels are recharged so that their glow remains bright.Intelligent terminals have both built-in processing and storage capacity.

4.6.2.3 Video Output

Screen image projector or data projector is an output device that displays information from the computer onto a large white screen.Audio response provides audio output from the computer.It is also used in video conferences, surveys, etc.Audio response is used by visually impaired to read information from the screen.For speech impaired people, audio response helps them to communicate with other people.Devices such as network adapters and sound cards are connected to expansion slots inside the computer.

Parallel Port

A parallel port is an interface for connecting eight or more data wires.The data flows through the eight wires simultaneously.

USB Port

Nowadays, USB is a common and popular external port available with computers.

Hard disk drive and new DVD drives

connect through firewire.

4.8 WORKING OF I/O SYSTEM

The working of I/O system combines I/O hardware and I/O software.The I/O software is the device driver software that may be embedded with operating system or comes with each device.

I/O Devices

are attached to computer via the ports of computer.It controls the signals on the wires of port or bus.The controllers have one or more registers for data and control signals.

Table 4. 1 lists the different I/O devices.

The data may be entered by typing or keying in, or by pointing a device to a particular location.

Cursor

moves with each typed character.

Description

The design of a keyboard is similar to a standard typewriter.Some keyboards have 110 keys, where the extra keys are designed to work with the Windows operating system.

The input data is not typed; instead, the data is entered by moving the pointing device.

4.4.2. 1 Mouse Features

It is the most common pointing input device.So, the cursor can be positioned at any location on the screen by simply moving the mouse.

The wheel of the mouse is used for the up and down movement, for example, scrolling a long document.

A mouse is classified as physical mouse or optical mouse.

This information is passed to computer via the mouse chord.

This information is sent to computer via the mouse chord.

Drag means pointing mouse to an object on screen, pressing the left button of mouse, keeping it pressed and moving the mouse to point to a new location.

The trackball device remains stationary.

Description

It is a stick with its base attached to a flexible rubber sheath inside a plastic cover.

The position of the stick movement is given by the x and y coordinates of the stick.

The electronic tablet is a flat bed tablet.

Each position on the tablet corresponds to a fixed position on the screen.

The input data is not typed; the data is entered by pointing the pick device directly on the computer screen.

Description

Touch screen consists of a clear glass panel that is placed over the view area of computer screen.

The computer can be operated using voice commands.

Video camera can capture full motion video images.

The information from the digital camera can be brought into the computer and stored.

Hand-held scanner and flat-bed scanner are the two common types of scanners.

Flat-bed Scanners provide high quality scan in a single pass.

The reading speed of MICR is faster than OCR.

The pattern of marks is interpreted and stored in the computer.

Goods available at supermarkets, books, etc.use barcode for identification.

4.6. 1.1 Printer

A printer prints the output information from the computer onto a paper.

Different kinds of printers are available for different types of applications.

Daisy Wheel Printers (Figure 4. 18) print one character at a time.

Drum Printers are line printers.

They are expensive and faster than character printers but produce a low quality output.

Non-Impact Printers do not hit or impact a ribbon to print.

Non-impact printers are faster and quieter than

impact printers. Ink-jet printers and laser printers are non-impact printers. Ink-jet Printers spray ink drops directly on the paper like a jet. Their resolution is more than 500 dpi. They produce high quality graphics and text. Plotter is a slow output device and is expensive. In a flatbed plotter, the paper is fixed on a flat bed. Computer Output on Microfilm (COM) is a high speed and low cost process. It can produce data in microfilm form at a much faster speed from that of a paper printer. The soft copy output requires a computer to be read or used. A monitor is of two kinds – monochrome display monitor and color display monitor. The clarity of image on the computer screen depends on three factors-- 1. More the number of pixels, the sharper is the image. Terminals are categorized as dumb, smart and intelligent terminals.

4.7 I/O PORT

The peripheral devices can be connected to computer in several ways. They can transmit eight bits of data in parallel. As a result, parallel ports provide high speed data transmission. A single USB port can support connection of up to 127 devices. The working of I/O system is described as follows--

There are many standard ports available on the backside of the computer case like serial port and parallel port. If one or more devices use a common set of wires, it is called a bus. For example, PCI bus, PCI Express bus, etc. Device Controller operates on a bus, a port or a device. Controller may be simple like a serial port controller for a serial port, or, complex like a SCSI controller. Some devices have their own built-in controllers. We may want to process data, write project reports, listen to sound recordings, watch a movie and do many more things.

4.2.1 Input Unit

4.2.2 Output Unit

Figure 4.1 shows some users working in an office. It is provided along with the computer, and is easy to use. It is used for entering the text data. The cursor on the computer monitor moves with the moving pointing device. The key benefit of using a mouse is that the cursor moves with the mouse. Physical Mouse has a rubber ball on the bottom side that protrudes when the mouse is moved. Using the mouse The mouse can be used in five different ways, as follows--

- Moving the mouse by hand moves the cursor on computer screen. The cursor moves in the direction in which the mouse moves. It is used to start a program or open a folder.
- Drag and Drop drags an object and drops it at another location.

Description Trackball looks like an upside-down mouse. The cursor on the computer screen moves in the direction in which the ball is moved. The buttons on trackball are used in the same way as mouse buttons. **Working** Trackball works in the same way as a physical mouse. The pen looks like a ball pen but has an electronic head. The pen is moved on the tablet. Light pen and touch screen are some common pick devices. It is used for making drawing, graphics and for menu selection. Figures and drawings can be made by moving the pen on computer screen. When the pen is moved on the screen, light from the screen at the location of pen causes the photocell to respond. The electric response is transmitted to the computer that can identify the position on screen at which the light pen is pointing. The computer selects the option from the menu of screen to which the finger points. Webcam is a common video camera device. Computer vision is an area of computer science that deals with images. They are difficult to use if there is a need to scan a full page document. These numbers are magnetized. The numbers in the bottom of the cheque include the bank number, branch number and cheque number. The hard copy output can be read or used without a computer. Impact printers can print a character or an entire line at a time. They are faster and expensive than impact printers.

4.6.2.1 Monitor

Monitor is a common output device. The common resolution of computer screen is 800x600 and 1024x768.

2. Parallel port

is used to connect printer to the

computer. Serial Port A serial port transmits one bit of data through a single wire. It is an expensive technology and is used for large data movement. It has data transfer rate of up to 400 MB/sec. Each device has its own device driver, and a device controller which is specific to the device.????The data is entered by pointing the mouse to a location on the computer screen. Description Mouse is a small hand-held device having two or three buttons on its upper side. In addition to the buttons, mouse also has a small wheel between the buttons. Pointing points to a location or object on the computer screen.??for the item on which the mouse is pointing.??The object gets dragged to the new location along with the mouse. When the left button of mouse is released, the object gets dropped at the new location. It is easy to use and takes less space than a mouse.??The marks are recognized by their darkness. ?They can print only in black and white. ??They can print 200–2500 lines per minute. ??The standard roll film is 16 mm wide with a film image that is 1/24 of the original document. The monitor is connected to the ???????.computer by a cable