Practical 01

Getting familiar with basic computer hardware: peripheral devices

Objectives

- To get familiar with basic computer hardware.
- Understand how computer processes data in to information.
- To get familiar with different input devices and their working mechanism.
- To get familiar with different output devices and their working mechanism.

Tools

- All the basic computer hardware.
- Different peripheral devices: Input and Output.
- Screw drivers.

Keywords: Data, Information, Pointing, Peripherals, Input, Output.	**Duration:** 03 hours

1 Introduction

1.1 Computer Defined

The computer is an electronic device, which is capable of receiving input, processing the data according to the given set of instructions, producing output and also capable of storing huge amount of data permanently. Computer is so called an electronic device because a computer is simply a machine which operates on the electric signals. There are many types of computers but the primary job of every computer is to convert raw data in to the useful information by applying some processing on the raw data according to the given set of instructions. The computer receives the data from the user via input devices then it applies some processing on to it with the help of processing devices (processor) and converts it into useful information then it shows that output on the output devices (like monitor or printer) and if requested it stores that processed data (information) on to any storage media (like hard disk or floppy disk etc.) permanently so that it can be accessed by the user at any time. Computer is basically a calculating device but the ability to store and execute programs makes computers extremely versatile and distinguishes them from calculators.

Computer helps us doing certain jobs in split seconds that the human even can't think of it. The computers are becoming the fundamental part of every field like they are widely used in industries, banks, insurance companies, universities, colleges, nuclear science, weather forecasting, weapon designing, car modeling, air crash investigation, Bio-medical sciences etc. because they perform

specific tasks very quickly, accurately and very fast. The computers that we see all around us in schools, colleges, universities and offices are digital computer.

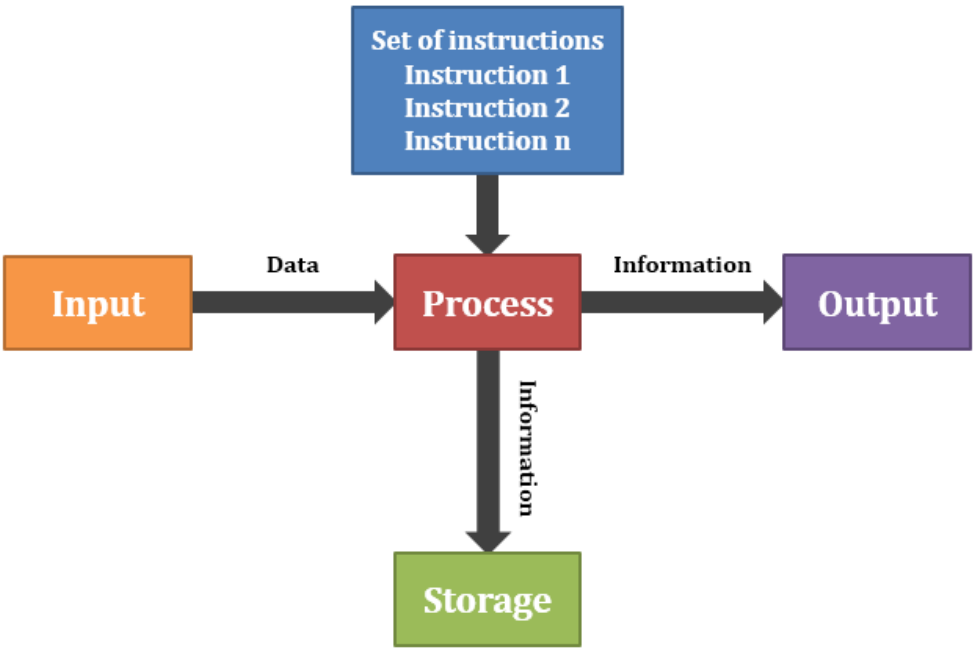
As there are many different types of computers therefore computers can't be classified in one or two categories. Computer can be classified in many aspects as according to type of data they can represent (i.e. Analog or Digital), according to the size, according to the data handling capabilities, according to the hardware they contain, according to the software they can support and many many more.

1.2 Basic task of a computer

No matter what type or size of the computer is the basic task of any computer is to convert raw data (useless data) in to information (useful data).

1.3 Information Processing Cycle

As the basic task of a computer is to convert the raw data in to the useful information. To do this task the computer performs a process called information processing cycle (also called data processing cycle), which is set of steps arranged in a particular manner. Each step of this process requires one or more components of the computer. Information processing cycle contains four steps:



INPUT: During this step the computer accepts the input from the user via any input device like keyboard or mouse. It is very important step as the computer cannot do anything by itself so it needs the instructions in the form of input.

PROCESS: During this step the processing devices (Microprocessor) of the computer performs some processing on the inputted data according to the given set of instructions and converts the data in to information. The data processed by the processor in stored in memory (RAM) temporarily so that the processor can receive and access the data very fast. So in this step the two important devices of the computer RAM and Processor are used.

OUTPUT: During this process the computer shows the result of processed data on some sort of output devices like monitor or printer. It is very important for the computer to show the output because if the computer cannot show the result then how a people can come to know that data has been converted in to information.

STORAGE: During this step the computer permanently stores the processed data on any storage device like hard disk, floppy or USB. It is important to save your important data on the permanently storage media so that you can access that data again whenever you want, else you have to set the data again which will be itching and can be time consuming to write the data again and again.

1.4 Input Devices

The input devices are used to enter the data into the computer (system unit) to instruct it to work accordingly. The input devices are considered as the interface between the user and the computer. Through the input devices the users can communicate and instruct the computer.

There are many types of input devices but the most commonly input devices used in a personal computer are keyboard and a mouse. The keyboard is used to enter the text and numbers, whereas the mouse is used to enter the data which is used by the computer to set the cursor on the screen. There are also many other input devices which may include the variants of mouse like, track ball and track pad; it may include optical input devices like a digital pen also called a stylus; the devices that input still and moving pictures which includes the digital camera and web cam; the devices to control the movement of the character in a computer game like, joystick or joy pad; the sound inputting devices like a microphone and many many more. List of some of the input devices is shown below:

- Keyboard
- Mouse
- Trackball
- Trackpad

- Joystick
- Game Controller
- Microphone
- Digital Camera
- Web Cam
- Barcode Reader
- Scanner
- Finger Print Reader

1.4.1 Keyboard

Keyboard is primary input device it is used to input text, numbers and commands. It is just like a typewriter which works as a communicator between the user and the computer. It is small plastic body containing matrix of several elastic keys arranged in certain groups. Keyboards can be categorized according to the shape, according to the size, according to the color, according to the number of keys they contain and so on. But the most commonly used keyboard is IBM Enhanced Keyboard designed by IBM, contains about 100 keys. These keys are arranged in to the five groups namely,

1. Alphanumeric Keys
2. Modifier Keys
3. Numeric Keypad
4. Function Keys
5. Cursor-Movement Keys

Alphanumeric Keys: The group of keys or the portion of the keyboard which looks like a typewriter containing alphabetic character (i.e. A, B, C, X, Y, Z), special symbols (i.e. &, @, $, #), numbers (i.e. 1, 2, 3, 4, 5) and some special keys as (ENTER, SPACE, BACK SPACE, CAPS LOCK and TAB) keys is named as Alphanumeric Keys. The first line in this group is arranged as Q, W, E, R T, Y, this arrangement is called QWERTY arrangement and sometimes the keyboard containing this type of arrangement are known as QWERTY keyboards. It is very important group because it enables us to enter the English syntax.

Modifier Keys: The keys SHIFT, ALT, CTRL are known as modifier keys because they modify or change the functionality of other keys. To modify the functionality of other key you have to press that key while holding down the modifier key. Like when you press J key it displays the small letter j on the screen but when pressed while holding down SHIFT key it will display capital J on the screen. Similarly F4 key has its own function but when pressed while holding down ALT key it closes any

opened active window. The modifier keys have played very important role in shrinking the size of the keyboard as if there were no modifier keys present in the keyboard then you had separate keys for capital and small letter and for some special functions so the modifier keys have helped very much to overcome this complex problem.

Numeric Keypad: It is just like a calculator located usually at the right side of the keyboard. It contains numbers from 0 to 9, arithmetic operator (+, -, *, & /), an enter key and a num lock key. It is used for fast calculation as it provides separate calculator based design. It is widely used in the fields where people perform a lot of calculations, creating data spread sheets and in accountings. The num lock key also plays an important role in this group, when the num lock key is activated this group behaves as a calculator while when deactivated it performs cursor-movement keys' functions.

Function Keys: The keys labeled as F1, F2, F3, . . . , F12 located usually at the top of the keyboard are known as function keys. These keys enable you to enter the commands without writing very long and complex syntax of certain command. These keys perform specific functions and each key has its own different functionality. As F1 key in most programs is used to open the help window of the program. The function of these keys can vary from program to program according to the structure of the program. The function of these keys like other keys can also be modified by using them with modifier keys as F4 key has certain function but when pressed while holding down ALT key it closes any opened active window.

Cursor-Movement Keys: The four arrow keys UP, DOWN, RIGHT & LEFT located between the alphanumeric keys and numeric keypad are known as cursor-movement keys because they can control the position of the cursor on the screen. These keys are used in wide variety of programs as they are used in word processing applications to move around in the document for changing the misplaced words, adding some text or removing unnecessary text added. Also in many games these keys are used to control the movement of the object in the game.

Beside these five groups the keyboard also contains two special purpose keys:

Start Key: It is used to open the start menu in many GUI (Graphics User Interface) based operating systems. The identity of this key is that the windows logo is labeled on to it. The keyboard contains two start keys one at the right and one at the left of space bar but both have the same functionality to open the start menu.

Shortcut Key: It is locate at the right side of the right start key. It is used to open the list of menus which that program contains. It has the same functionality as right mouse button has. So, pressing the shortcut key means right clicking the mouse.

The latest developments in the keyboard manufacturing are Multimedia and Internet keyboards. The multimedia keyboards contain some extra features that control the multimedia capabilities of your system. These keyboards include some extra buttons as play, stop, pause, forward, rewind, volume controlling key etc. These keyboards control the volume of your system and can control your media player. On the other hand the Internet keyboard controls the Internet features of your system as you can open a web page by just pressing a single button also you can send an e-mail with the touch of a single button. Now days, these two developments are becoming more and more popular among the people.

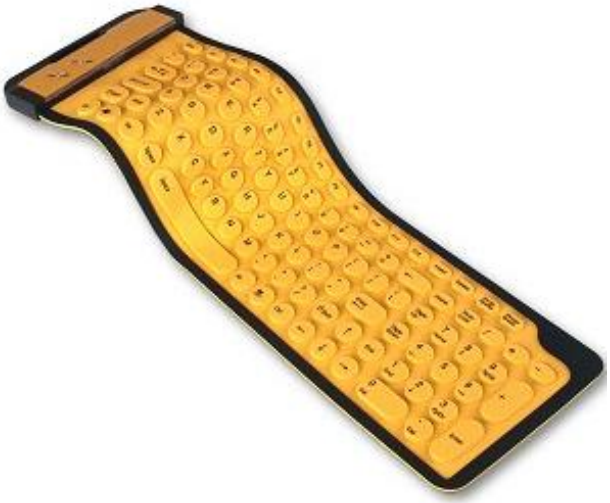
1.4.1.1 Mini-Keyboard

Mini-keyboards as their name implies are the smaller keyboards then the standard keyboards but have same functionality as found in standard keyboards. The mini-keyboards lack one feature i.e. numeric keypad that is usually found at the right side of a standard keyboard. The keyboard manufacturers have been struggling to shrink the size of the keyboard without eliminating certain features. They have realized that the numeric keypad is an extra feature which occupy about one third of a whole keyboard and can be eliminated because the same keys i.e. numeric keys 0-9, & arithmetic operators +, -, /and * are also available in alphanumeric keys. In this way by eliminating numeric keypad, the size of the keyboards has reduced without eliminating certain features. These mini-keyboards are lighter in weight and take less desk space than the standard keyboards. These keyboards are ideal for home desktop and office desktop PCs, where we do not have more room for huge devices. But the professionals who every time deals with numbers and calculations will not feel comfortable with these devices. These devices like other keyboards are available in both wired and wireless forms and can be available in PS/2 or USB ports.

1.4.1.2 Fold-Out/ Roll-Up Keyboards

The fold-out keyboards are the newest development in the keyboard manufacturing technology. These keyboards are so flexible that they can be easily fold-out like a paper sheet for easy carrying therefore these keyboards are also known as roll-up or flexible keyboards. The whole casing and the buttons of these keyboards are made up of rubber type material and this elastic rubber material is actually the responsible for such flexibility in these devices. Although these devices are so much flexible in terms of mechanism but are not so much flexible in working because these devices always require a flat hard surface to sit on to work properly. These keyboards are very expensive as compared to the other keyboards and are not widely used because of their short life.

These devices have got one major advantage that they can be cleaned easily as there are no hollow surfaces under the sides of the keys as found in other keyboards. These devices are available in both wired and wireless forms but the manufacturers are very keen to build wireless fold-out keyboard to make them even more flexible.



1.4.1.3 Keypads

Keypads are the smallest type of keyboards contain only single group of keys i.e. numeric keys from 0-9 and arithmetic operators +, -, / and *. These are even smaller and lighter than mini-keyboards. They are only used for entering numeric data and cannot enter characters. These types of devices are ideal for workplaces where the people every time deal with numbers and calculations and there these devices play the role of a calculator. These devices are not so much flexible as they can only enter numeric type data so you should be very much careful when purchasing these devices by keeping in your mind that for what purpose you are going to purchase them either for professional numeric data entry or for office work. If you are purchasing keypads for office use then you are at wrong way and you will only put your hand on your head and say oh! What I have purchased?

If you are a regular computer user you should have a standard or a min keyboard. As you are a regular user you should know that sometimes operating system corrupts. In this case you have to reinstall the operating system but the most operating systems come with serial number also known as product key which is series of 25-characters long alphanumeric string. At this time your numeric keypad will not be able to input the whole product key. So it is recommended that you should have a standard or min-keyboard with the numeric keypad for full functionality.

1.4.1.4 Round Mini-Keyboards

As there name implies they are circular shaped keyboards. These keyboards are even smaller then mini-keyboards. These are full-

featured keyboards which have same functionality as offered by traditional standard keyboards. They are usually operated by single hand. These are portable and easy-to-use devices which occupy less desk space.

If you see carefully some of the alphabetic keys are missing in this keyboard. Because normally you have a pair of round mini keyboards, so there will be another round keyboard and the missing keys will be present in that keyboard. You have pair of round mini keyboards, one for your left hand and one for your right hand.

1.4.1.5 Projection Keyboard

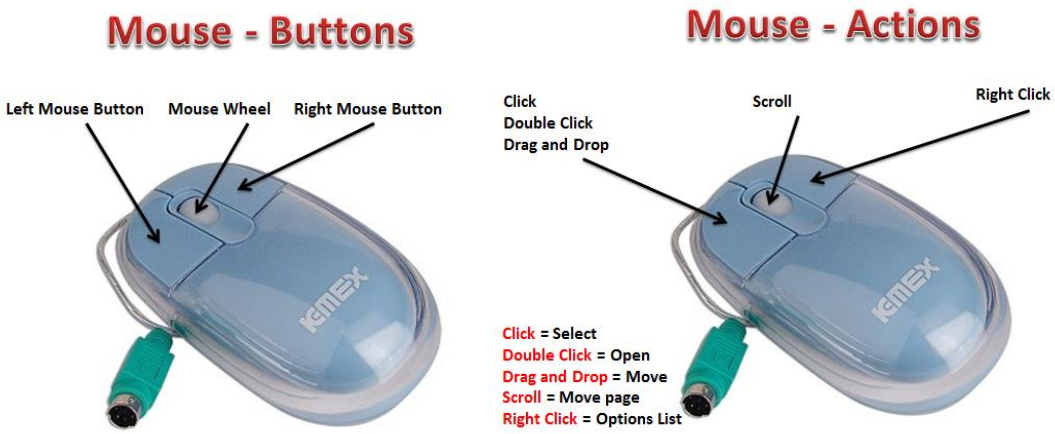
A projection keyboard is a form of computer input device whereby the image of a virtual keyboard is projected onto a surface: when a user touches the surface covered by an image of a key, the device records the corresponding keystroke.

1.4.2 Mouse

Mouse (plural Mice) is a pointing device. It was invented by Douglas Englebart in 1963, who at the time was working at the Stanford Research Institute. It is used to control the cursor on the screen. The movement of the cursor is controlled by moving the mouse, when we move the mouse forward the cursor moves upwards and when we move it backward the cursor moves downwards. You can also move the mouse in left and right direction to move the cursor left and right. The mouse can have at least two buttons one is called left mouse button and the other is called right mouse button. The left mouse button is used for functions like clicking, double-clicking and dragging and right mouse button is used for right-clicking. Clicking, double-clicking, dragging and right-clicking are the functions that make the mouse more flexible and more function able. Today's modern mouse have a scrolling wheel, located between right and left mouse button, used to scroll around a large documents or web pages quickly.

The mouse is used in GUI (Graphical User Interface) based operating systems. It allows the users to interact with the on-screen pop-up menus and dialog boxes. The mouse offers two main advantages firstly, you can easily and quickly move around the screen and secondly, you can enter commands

without entering and remembering the large and complex syntax of the commands. Mice like other peripherals are available in different shapes and sizes. A mouse can be as large as a human hand or a mini sized mini-mouse. The mouse can be in wired or wireless form. The mice are available in Serial, PS/2 and USB ports.



1.4.3 Types of mouse

There are two types of mouse:

1. Mechanical Mouse
2. Optical Mouse

1.4.3.1 Mechanical Mouse

This is a traditional mouse, which works on mechanical basis, containing a rubber ball which protrudes from the back of the mouse casing through a hole. It also contains a pair of rollers and sensors. When you move the mouse the ball at the bottom moves and with it the roller that are in contact with the ball also rolls then the sensors send the signals to the computer telling it the distance, direction and speed of the move. Then the computer uses its stored data to set the cursor on the screen so in this way the position of the cursor is controlled on the screen.

1.4.3.2 Optical Mouse

Optical mouse is the newest development in the mouse sometimes also called lesser mouse, because the laser is at the heart of this mouse. This mouse contains a built-in lesser instead of a heavy rubber ball. When you mouse this mouse the lesser emits the beam of lesser light and with the help of reflected rays it identifies the distance, direction and speed of the move and sends the signal to the computer and then the computer uses its own stored data to set the cursor on the screen. As this

mouse does not contain a ball therefore this is slightly lighter than the mechanical mouse. People often use optical mouse instead of mechanical mouse because of its better performance.

1.4.4 Trackball

Track ball is a pointing device. Like mouse it is also used to control the cursor on the screen. It is just like up-side down mouse. It contains a rubber ball on the top of it and two or more buttons. To use this device you have to place your thumb or index finger on the ball and other fingers on the buttons. With the help of index finger you can roll the ball and control the cursor on the screen as you desire. As you don't have to move the whole device therefore it is ideal for the places where you don't have enough room for mouse. Track balls are widely used in laptop computers because you do not have enough space at you lap to move the mouse.

Track balls come in many different varieties. Some track balls are heavy with a huge ball and some are very light and contain very small ball. Track balls also come in left and right hand model for left and right-handed people. Track ball like mouse can contain two or more buttons and scrolling wheel.

1.4.5 Trackpad

Track Pad is a pointing device also called touch pad. It is small pad approximately the size of 1.5 or 2 inches. It is used to control the cursor on the screen. To use this device you have to move your index finger on the pad and the motion of your finger is then translated into the cursor's movement. As it is approximately 1.5 or 2

inches wide so your finger doesn't have to move very far therefore it is less tiring to use track pad instead of using mouse or trackball. It also contain two or more buttons but some track pads are strike sensitive that is you just have to tap the pad instead of pressing certain buttons. Track pads are now widely used in laptop computers. Track pads are also now built-directly in to the modern keyboards releasing the extra port for other devices. You can also buy a separate track pad like mouse and keyboard but you will consume one extra port for it.

1.4.6 Joystick

Joystick is a type of game controller which looks like a car's gear contains a lever and some buttons. The lever is used to control the direction and motion of the object in the game and other buttons perform some specific functions. The joystick is ideal for playing racing and flying games. A joystick is a personal computer peripheral or general control device consisting of a handheld stick that pivots about one end and transmits its angle in two or three dimensions to a computer. Joysticks are often used to control video games, and usually have one or more push-buttons whose state can also be read by the computer. The term joystick has become a synonym for game controllers that can be connected to the computer since the computer defines the input as a "joystick input". Apart for controlling games, joysticks are also used for controlling machines such as elevators, cranes, trucks, powered wheelchairs and some zero turning radius lawn mowers. More recently miniature joysticks have been adopted as navigational devices for smaller electronic equipment such as mobile phones. There has been a recent and very significant drop in joystick popularity in the gaming industry. This is caused by the lack of new simulation games, flight for the most part.

1.4.7 Game Pad

Gamepad, also called joypad or control pad, is a type of game controller held in the hand, where the digits (especially thumbs) are used to provide input. Gamepads generally feature a set of action buttons handled with the right thumb and a direction controller handled with the left. The direction controller has traditionally been a four-way digital cross (D-pad), but most modern controllers additionally (or as a substitute) feature an analog stick. Gamepads are also available for personal computers, although a keyboard and mouse combination tends to be utilized more often for certain genres.

1.4.8 Microphone

It is an input device used for sound input. It catches the analog signals of sound and sends them to the sound card which converts those analog signals into the digital form that the computer can understand. To use a microphone you should have a sound card which can convert the sound into the computers own language so the computer can understand. You can record the sound with the help of microphone and store it to the computer. Microphones are very useful in audio and video conferences and presentations. Latest concept in the computer field is to input the text without interacting with the keyboard by only pronouncing the words with the help of microphone. The software called Speech Recognition Software does this job by translates the speech into the text. It takes the smallest individual sounds in a language, called phonemes, and translates them into text or commands. It is very complex software as in English language there are some words which have same sounds and also it depends up on the speaker how he or she pronounces certain words. It does not guarantee for 100 percent accuracy.

1.4.9 Digital Camera

It is again an input devices used to input the still images into the computer. It is very much identical to the traditional camera found in the hands of a professional photographer usually called a film camera which captures the images on a special carbon coated film but the computers digital camera captures the image in a special memory chip. These are portable handheld devices that you can easily carry to any place to captures your favorite stills. Some digital cameras offer a small screen on to which you can see the captures stills. You

can transfer the images stores in the memory chip in the computer and can use a software to modify and enhance it.

1.4.10 Web Camera

Web camera usually known as Web Cam is an input device used to input videos (moving pictures). The difference between this device and a digital camera is that the digital camera captures only still image whereas this device can capture moving pictures usually known as videos. Web cam is very handy tool most commonly used in video conference on the Internet. You can use this device to communicate with your friends face to face on the Internet. People usually set this device to the top of their monitors. This camera digitizes the image by breaking them into individual pixels. Each pixel's color and characteristics are stored as digital code. This code is then compressed so that it can be stored on the disk or transmitted over a network. Most of the laptops have built-in web cam at the top center.

1.4.11 Barcode Reader

A barcode reader (or barcode scanner) is a computer peripheral for reading barcodes printed on various surfaces. Like a flatbed scanner, it generally consists of a light source, a lens and a photo conductor translating optical impulses into electrical ones. Additionally, nearly all barcode readers currently produced contain decoder circuitry analyzing the barcode's image data provided by the photo conductor and sending the barcode's content to the scanner's output port. Bar code reader reads the special Bar codes, which are the patterns of small printed lines that appear on product packages. The bar code reader emits a beam of lesser light on the printed bars. A light-sensitive

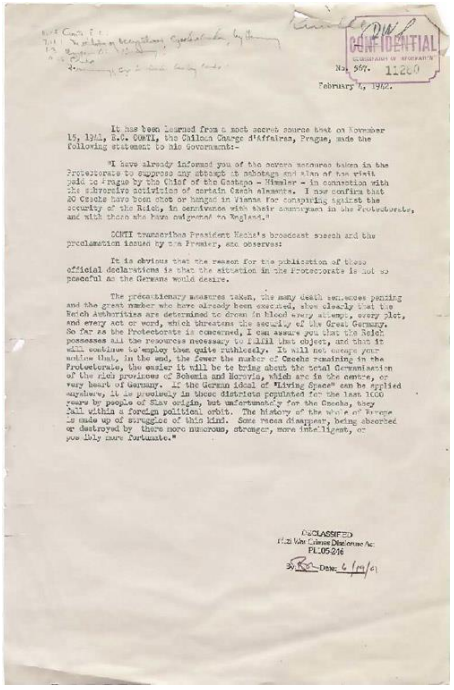
detector identifies the bar codes so as the product. It is used as a product identifier. These special bars on each different product are different. After the detector identifies the bar codes, it converts the individual bar patterns into the numeric digits that are then matched with the data stored in the computer which tells whether the product is genuine or not.

1.4.12 Scanner

A scanner is an input device used to input the soft copy of a printed document. The image scanner or simply scanner converts a printed document in to digital form by shinning the lesser light on the image and with the help of reflected rays of light it identifies the colors and intensity of the colors. The color scanner uses RGB (Red, Green and Blue) color scheme.

You can now save that digital image into your computer and use software like Adobe Photoshop or Corel Draw to modify that image by increasing the brightness, color intensity, saturation, hue etc. If

you scan a text document the scanner will convert it in to an image but not in to a document. You can use software named as Optical Character Recognition (OCR) to convert that scanned image in to a document format. This software contains some assumptions that how the characters will look like and matches the characters of an image with its assumptions and converts that image file into a document format. Now when the OCR has converted the image into a document you can edit and modify it. Although it is very complex software because the hand-writing varies from person to person and this software contains only a few assumptions so this software does not guarantee to convert the hand-writing of every person.



1.4.13 Finger Print Reader

It is a device which captures the finger print by striking the laser light over the finger and the reflected light is captured through sensors and is translated in to digital images (finger print).

Fingerprint scanning is a standard biometric method that authenticates a user's identity based upon who they are. Even though authentication using

finger print scanning attempts to verify identities by using a completely unique characteristic, it is not 100% secure or reliable.

A user's fingerprint consists of a number of ridges and valleys on the top layer of skin. A fingerprint scanner plate using optics or capacitors collects a print sample of the pattern of peaks and valleys, converts the pattern to a number or algorithm, and compares it to other stored templates.

Most of the laptops have nowadays built-in finger print reader.

1.5 Output Devices

The output devices are used to display the result of processed data (information). The computer produces the result by accepting the data from user via input devices and by performing some processing operations on to it. Now this result is very much meaningful to the users and there must be a device at which this result should be displayed and this task is performed by the output devices.

There are many types of output devices but the most commonly used output devices in a personal computer are the monitor and printer. The monitor shows the result temporarily by creating the soft copy while the printer shows the result permanently by creating the hard copy. There are also some other output devices like, plotter which is a special printing device, speakers which produces the sound output and many other devices.

Some of the output devices are listed below:

- Monitor
- Printer
- Plotters
- Speakers
- Projector

1.5.1 Monitor

A computer monitor, usually called simply a monitor, is a piece of electrical equipment which displays viewable images generated by a computer without producing a permanent record. The word "monitor" is used in other contexts; in particular in television broadcasting, where a television picture is displayed to a high standard. A computer monitor is usually either a cathode ray tube or some form of flat panel such as a TFT LCD display. The monitor comprises the display device, circuitry to generate a picture from electronic signals sent by the computer, and an enclosure or case. Within the computer, either as an integral part or a plugged-in interface, there is circuitry to convert internal data to a format compatible with a monitor.

Along with the mouse and keyboard, the video display (monitor) is a vital part of the user interface of any computer. Actually, it is a latecomer to computing; before CRT monitors came into general use, the teletypewriter was the standard computer interface—a large, loud device that printed the input and output characters on a roll of paper. The first CRT displays used on computers were primitive by today's standards; they displayed only text in a single color (usually green), but to users at the time they were a great improvement, allowing real-time display of input and output data. Over time, color displays were introduced, screen sizes increased, and LCD technologies moved from the portable computer to the desktop.

Today, PC video displays are much more sophisticated, but you must be careful when selecting video hardware for your computer. A slow video adapter can slow down even the fastest and most-powerful PC. Incorrect monitor and video adapter combinations can also cause eyestrain or be unsuitable for the tasks you want to accomplish.

The video subsystem of a PC consists of two main components:

Monitor (or video display): The monitor can be either a CRT (Cathode Ray Tube) or an FPD (Flat Panel Display).

Video adapter (also called the video card or graphics adapter): On many recent low-cost systems, video might be built into the motherboard or included as part of this motherboard's chipset.

1.5.2 Types of Monitors

There are two basic types of monitors:

1. CRT (Cathode Ray Tube)
2. FPD (Flat Panel Display)

1.5.2.1 CRT (Cathode Ray Tube)

A monitor can use one of several display technologies. The original display technology, and still the most popular, is cathode ray tube (CRT) technology—the same technology used in television sets. The CRT monitors are the monitors which rely on Cathode Ray Tube for displaying the images. The CRT or Cathode Ray Tube is the picture tube of a monitor. The back of the tube has a negatively charged cathode. CRTs consist of a vacuum tube enclosed in glass. One end of the tube contains an electron gun assembly that projects three electron beams, one each for the red, green, and blue phosphors used to create the colors you see onscreen; the other end contains a screen with a phosphorous coating.

There are two electromagnets around the collar of the tube which deflect the electron beam. The beam scans across the top of the monitor from left to right, is then blanked and moved back to the left-hand side slightly below the previous trace (on the next scan line), scans across the second line and so on until the bottom right of the screen is reached. The beam is again blanked, and moved back to the top left to start again. This process draws a complete picture, typically 50 to 100 times a second. The number of times in one second that the electron gun redraws the entire image is called the refresh rate and is measured in hertz (cycles per second). It is common, particularly in lower-priced equipment, for all the odd-numbered lines of an image to be traced, and then all the even-numbered lines; the circuitry of such an interlaced display need be capable of only half the speed of a non-interlaced display. An interlaced display, particularly at a relatively low refresh rate, can appear to some observers to flicker, and may cause eyestrain. Whenever the beam strucks the phosphor dots they glow. This light is what you see when you watch TV or look at your computer screen. Three layers of phosphors are used: red, green, and blue. A metal plate called a shadow mask is used to align the electron beams; it has slots or holes that divide the red, green, and blue phosphors into groups of three (one of each color). Various types of shadow masks affect picture quality, and the distance between each group of three (the dot pitch) affects picture sharpness.

The image on the monitor screen is usually made up from at least tens of thousands of such tiny dots glowing on command from the computer. The closer together the pixels are, the sharper the image on screen. The distance between pixels on a computer monitor screen is called its dot pitch and is measured in millimeters. Most monitors have a dot pitch of 0.28 mm or less.

1.5.2.2 FPD (Flat Panel Display)

Flat panel displays encompass a growing number of technologies enabling video displays that are lighter and much thinner than traditional television and video displays that use cathode ray tubes, and are usually less than 4 inches (100 mm) thick. The Flat panel displays require continuous refresh. These flat panel displays has given the birth to the number of technologies which include:

- Digital Light Processing (DLP)
- Plasma Display Panels (PDPs)
- Liquid Crystal Displays (LCDs)
- Organic Light-Emitting Diode Displays (OLEDs)
- Light-Emitting Diode Display (LED)
- Electroluminescent Displays (ELDs)
- Surface-Conduction Electron-Emitter Displays (SEDs)
- Field Emission Displays (FEDs)
- Nano-Emissive Display (NEDs)

Only the first five of these displays are commercially available today, though OLED displays are beginning deployment only in small sizes (mainly in cellular telephones). SEDs are promised for release in 2006, while the FEDs and NEDs are in the prototype stage.

Flat panel displays balance their smaller footprint and trendy modern look with high costs and in many cases inferior images compared with traditional CRTs. In many applications, specifically modern portable devices such as laptops, cellular phones, and digital cameras, whatever disadvantages are overcome by the portability requirements.

1.5.3 Differences between CRT and FPD

CRT (Cathode Ray Tube)	**FDP (Flat Panel Display)**
Heavier in weight.	Lighter in weight.
Bulky in size.	Thin in size.
Consumes more power.	Consumes less power.
Consumes more space.	Consumes less space.
Has greater viewing angle.	Has smaller viewing angle.
Cheaper than FPD.	Expensive than CRT.
Has concave or convex shaped screen.	Has flat screen.
Not suitable for portable computers.	Ideal for portable computers (e.g. laptops)

1.5.4 Printer

A printer is an output device, which produces a hard copy (permanent human-readable text and/or graphics) of documents stored in electronic form, usually on physical print media such as paper or transparencies. Many printers are primarily used as computer peripherals, and are permanently attached by a printer cable to a computer which serves as a document source. Other printers, commonly known as network printers, have built-in network interfaces (typically wireless or Ethernet), and can serve as a hardcopy device for any user on the network.

In addition, many modern printers can directly interface to electronic media such as memory sticks or memory cards, or to image capture devices such as digital cameras, scanners; some printers are combined with a scanners and/or fax machines in a single unit. A printer which is combined with a scanner can essentially function as a photocopier.

Printers are designed for low-volume, short-turnaround print jobs; requiring virtually no setup time to achieve a hard copy of a given document. However, printers are generally slow devices (30 pages per minute is considered fast; and many consumer printers are far slower than that), and the cost-per-page is relatively high.

In contrast, the printing press (which serves much the same function), is designed and optimized for high-volume print jobs such as newspaper print runs-printing presses are capable of hundreds of pages per minute or more, and have an incremental cost-per-page which is a fraction of that of printers.

The printing press remains the machine of choice for high-volume, professional publishing. However, as printers have improved in quality and performance, many jobs which used to be done by professional print shops are now done by users on local printers.

1.5.5 Plotters

A plotter is a vector graphics printing device that connects to a computer. Plotters print their output by moving a pen across the surface of a piece of paper. This means that plotters are restricted to line art, rather than raster graphics as with other printers. They can draw complex line art, including text, but do so very slowly because of the mechanical movement of the pens. (Plotters are incapable of creating a solid region of color; but can hatch an area by drawing a number of close, regular lines.) When computer memory was very expensive, and processor power was very slow, this was often the fastest way to produce color high-resolution vector-based artwork, or very large drawings efficiently.

Traditionally, printers are primarily for printing text. This makes it fairly easy to control, simply sending the text to the printer is usually enough to generate a page of output. This is not the case of the line art on a plotter, where a number of printer control languages were created to send the more

detailed information like "draw a line from here to here". The two common ASCII based plotter control languages are Hewlett Packard's HPGL or Houston Instruments DMPL with commands such as "PA 3000, 2000; PD".

Programmers in FORTRAN or BASIC generally did not program these directly, but used software packages such as the Calcomp library, or device independent graphics packages such as Hewlett-Packard's AGL libraries or BASIC extensions or high end packages such as DISSPLA. These would establish scaling factors from world coordinates to device coordinates, and translating to the low level device commands. In HP 9830 BASIC, it was actually simpler to write a plotting program than today with C#.NET.

Early plotters (e.g. the Calcomp 565 of 1959) worked by placing the paper over a roller which moved the paper back and forth for X motion, while the pen moved back and forth on a single arm for Y motion. Another approach (e.g. Computervision's Interact I) involved attaching ball-point pens to drafting pantographs and driving the machines with motors controlled by the computer. This had the disadvantage of being somewhat slow to move, as well as requiring floor space equal to the size of the paper, but could double as a digitizer. A later change was the addition of an electrically controlled clamp to hold the pens, which allowed them to be changed and thus create multi-colored output.

Plotters are used primarily in technical drawing and CAD applications, where they have the advantage of working on very large paper sizes while maintaining high resolution. Another use has been found by replacing the pen with a cutter, and in this form plotters can be found in many garment and sign shops. If a plotter is commanded to use different colors it has to replace the pen and select the wanted color. A niche application of plotters is in creating tactile images for visually handicapped people on special thermal cell paper.

1.5.6 Speaker

Speaker is an output device which produces sound. Computer speakers range widely in quality and in price. The computer speakers typically packaged with computer systems are small, plastic, and have mediocre sound quality. Some computer speakers have equalization features such as bass and treble controls.

The internal amplifiers require an external power source, usually an AC adapter. More sophisticated computer speakers can have a subwoofer unit, to enhance bass output, and these units usually include the power amplifiers both for the bass speaker, and the small satellite speakers.

Some computer displays have rather basic speakers built-in. Laptops come with integrated speakers. Restricted space available in laptops means these speakers usually produce low-quality sound.

1.5.7 Speaker Channels

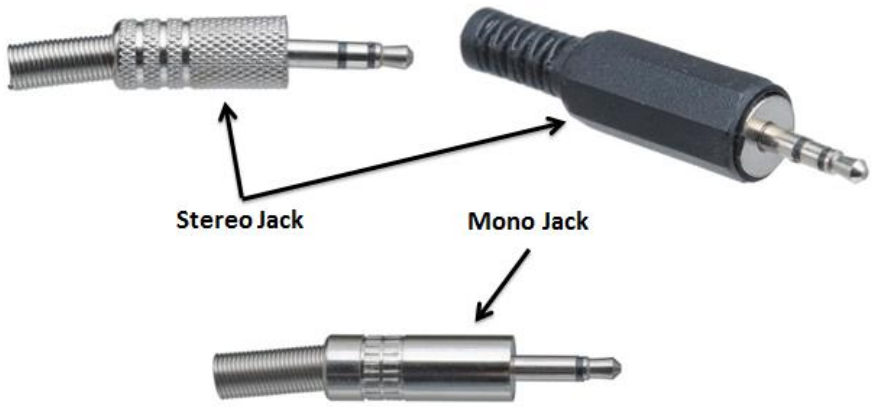
The sound systems have different number of channels which determine the number of speakers that can be connected to that system known as channels. Three of the sound channels types are:

1. Mono
2. Stereo
3. Surround Sound

The mono sound contains only 1 channel, it means no matter how many speakers you are connecting to the mono sound system you will have same sound in all the speakers.

The stereo sound contains 2 channels, it means two speakers can be connected and in each speaker you will have different sound. One for your left ear and one for your right.

The surround sound contains more than 2 channels (usually 5, 6, 7, 8, 9, or 10 channels), it means more than 2 speakers can be connected and in each of the speaker you will have different sound.



1.5.8 Variants of speakers

Other forms of speakers are:

- Headphones
- Earphones

1.5.9 Projector

An image projector is an Optical device that projects an image (or moving images) onto a surface, commonly a projection screen.

Most projectors create an image by shining a light through a small transparent image, but some newer types of projectors can project the image directly, by using lasers.

The most common type of projector used today is called a video projector. Video projectors are digital replacements for earlier types of projectors such as slide projectors and overhead projectors. These earlier types of projectors were mostly replaced with digital video projectors throughout the 1990s and early 2000s (decade), but old analog projectors are still used some places. The newest types of projectors are handheld projectors that use lasers or LEDs to project images. Their projections are hard to see if there is too much ambient light. Movie theaters use a type of projector called a movie projector.

EXERCISE

1. What different input and output devices you found in the lab. For each of the device fill in the following:

Device Name	Brand Name	Type/Mechanism	Type of Data	Input/Output

Device Name = Name of Input or Output.
Brand Name = Company Name device manufactured by.
Type/Mechanism = Type of device or working mechanism. For example: For mouse specify whether it is optical or mechanical, for monitor specify whether it is Cathode Ray Tube or Flat panel Display.
Type of Data = Specify the type of data, the device inputs or output. For example: Image, Text, or Sound.
Input / Output = Specify whether the device is an input device or output device.

2. For each of the following devices list few names of the software applications that uses them intensively:

- **Keyboard**
- **Mouse**
- **Microphone**
- **Scanner**
- **Digital Camera**
- **Printer**
- **Speaker**
- **Webcam**
- **Joystick**