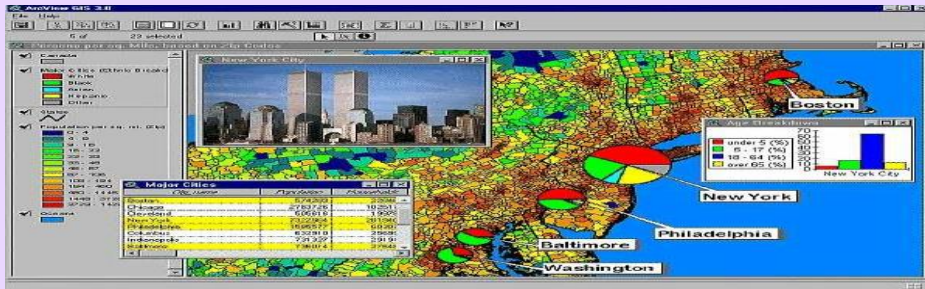


*Dr. Ibraheem Yousif*

# Geographic Information Systems

## {GIS}

## Components of GIS

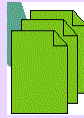
1. Hardware
2. Software
3. Data
4. People-Human Resources
5. Method-and operating Practices

## Components of GIS

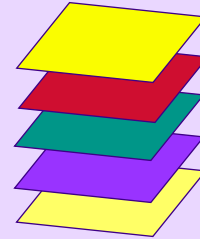
### ◆ System with 5 basic components



Software



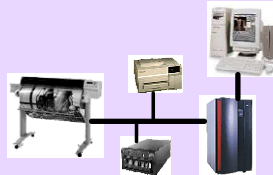
Procedures



Database

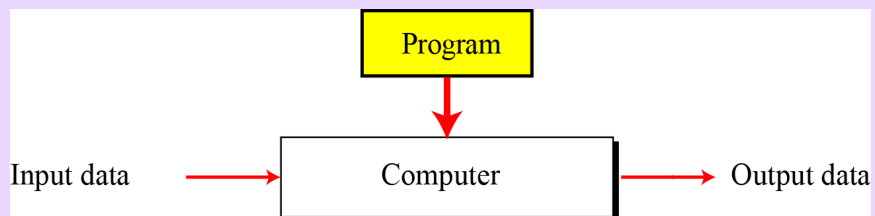


People

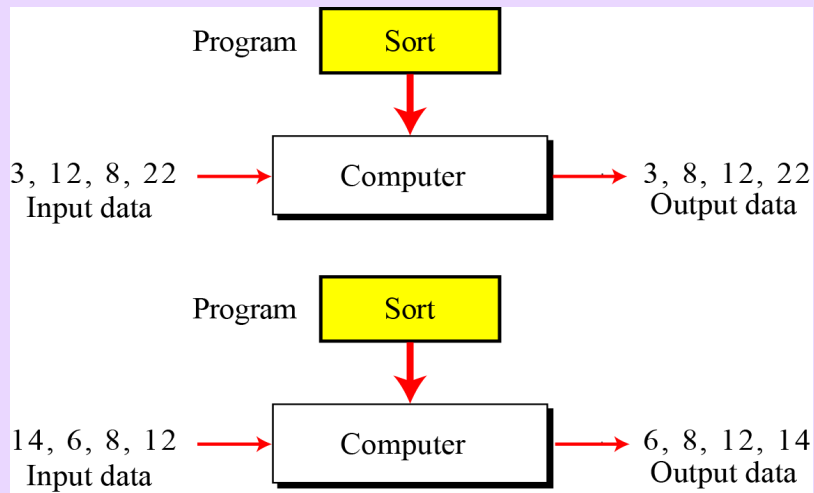


Hardware

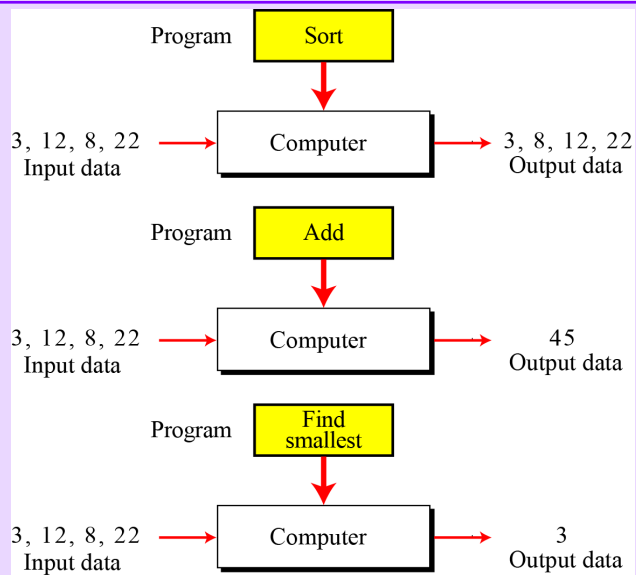
## Computer System



## The same program, different data



## The same data, different programs



## Components of computer

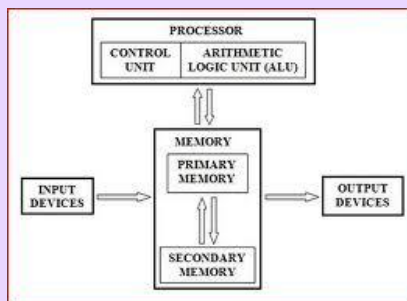
Hardware, in the computer world, refers to the **physical** components that make up a computer system.



1. **Data Input Unit**
2. **Central Processing Unit and Storage**
3. **Data Output Unit**

## Central Processing Unit

- ◆ The Central Processing Unit (CPU) is responsible for **interpreting** and **executing** most of the commands from the computer's hardware and software.
- ◆ The CPU could be considered the "**brains**" of the computer.



## Random Access Memory (RAM)

- **R**andom **A**ccess **M**emory(RAM) is the "working memory" in a computer.
- RAM allows a computer to work with more information at the same time which can have a **dramatic effect on total system performance**.
- The volume of data stored in the memory units measured by: **bit, byte, kilo bytes Kbytes, Megabytes, Gigabytes and Terabytes**

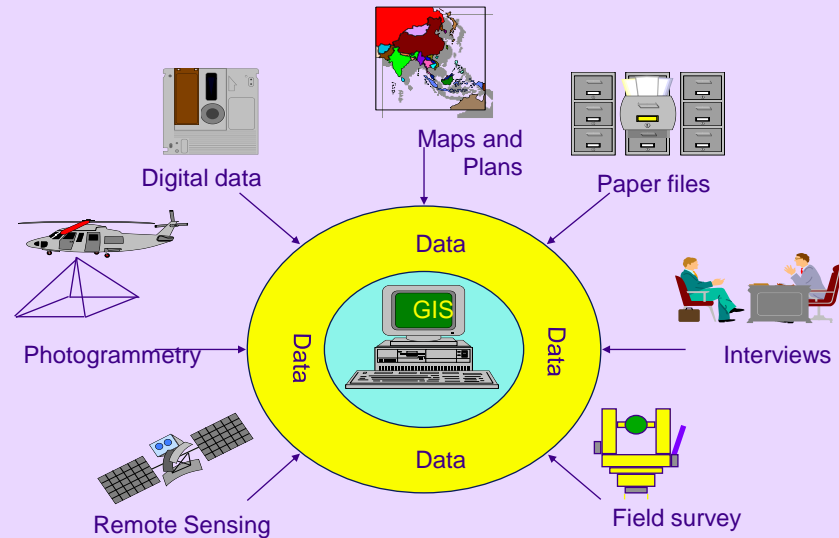


Hardware

Input

Output

## GIS Data Sources



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## Advantages of digital maps over paper

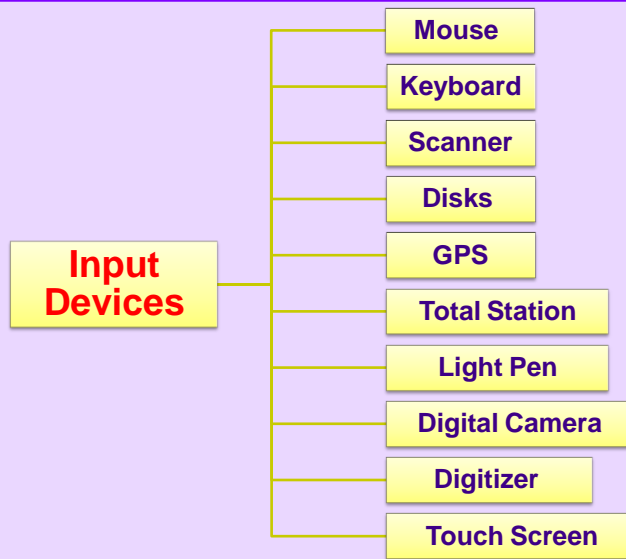
- ◆ Easier to produce
- ◆ Easier to store
- ◆ Easier to distribute
- ◆ Dimensional stability

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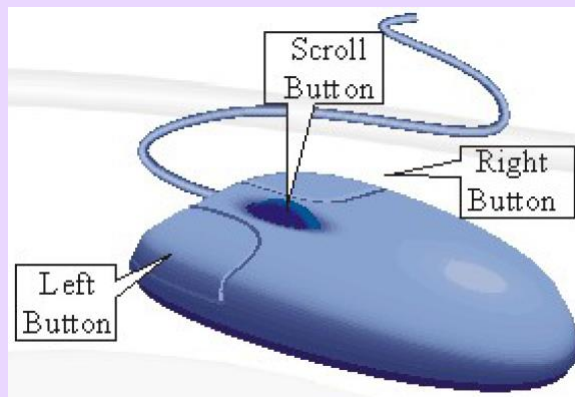
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# Data Input Units



## 1. Mouse

- **Mouse:** Mouse is a **pointing** device that allows user to point to a specific position on the screen.
- It has two or three buttons on top for selecting/executing different operations.



# 1. Mouse

- Pressing buttons of mouse is known as **clicking** of mouse.
- The mouse is placed on flat surface and moved around to move its **controlling** arrow on screen.
- The arrow showing the position of mouse on screen is known as mouse **pointer**.
- Left button of mouse is used **execute** the operation associated with it.
- Right button/Middle buttons are associated with special **operations** in different situations.

# 2. Keyboard

**Keyboard:** Keyboard is the **most popular** input device that allows users to **type** alphabets, numbers, and operators, and also to **control** the cursor on the screen. A simple keyboard layout is given below



## 3. Scanner

- It is a device used to **capture** digital images of printed documents, graphics or other printed media.
- A scanner, simply put, is a device used to **analyze** an image and process it.

*So what is a scanner?*



## Anatomy of a Scanner

1. Charge-coupled device (CCD) array
2. Mirrors
3. Scan head
4. Glass plate
5. Lamp
6. Lens
7. Cover
8. Filters
9. Stepper motor
10. Stabilizer bar
11. belt
12. Power supply
13. Interface port(s)

# How Scanners Work

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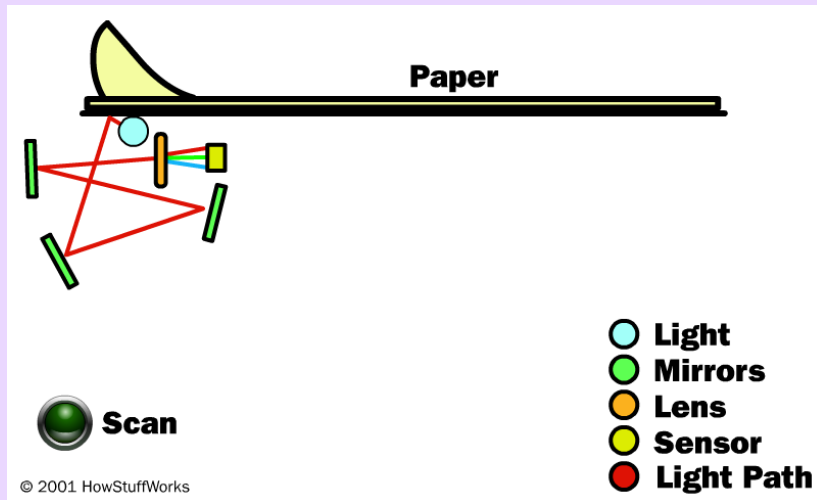
1. The document is placed on the **glass plate** and the cover is closed.
2. A **lamp** is used to **illuminate** the document. The lamp in **newer scanners** is either a **cold cathode fluorescent** lamp (CCFL) or a **xenon** lamp, while **older** scanners may have a standard **fluorescent** lamp.
3. The entire mechanism (**mirrors, lens, filter** and **CCD** array) make up the **scan head**. The scan head is **moved slowly** across the document by a **belt** that is attached to a **stepper motor**.

# How Scanners Work

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4. The **image** of the document is **reflected** by an angled **mirror** to **another** mirror. In some scanners, there are only **two mirrors** while others use a **three mirror** approach. Each mirror is slightly **curved** to **focus** the image it reflects onto a smaller surface.
5. The **last mirror reflects** the image onto a **lens**. The lens **focuses** the image through a filter on the CCD array.

# How Scanners Work



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## One size does not scan all!

There are different **types** of scanners for different types of documents that need to be scanned.

- ◆ Flatbed Scanners
- ◆ Sheet-fed Scanners
- ◆ Handheld Scanners
- ◆ Drum Scanners

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## Flatbed Scanner

- ◆ Used for scanning most documents, photos, and even flat objects from a PC or laptop.
- ◆ Flatbed scanner works like a **copy machine**.
- ◆ Scans documents placed **face down** on the glass (scan bed)
- ◆ **Most common** type of scanner.



## Sheet-fed Scanner

- ◆ More **portable** than a flatbed scanner.
- ◆ Used to scan paper documents and photos.
- ◆ The paper **moves** through the scanner.
- ◆ Usually **smaller** than a flat-bed and portable.



## Handheld Scanner

- ◆ **Smaller** than the previous two scanners.
- ◆ The user **must move** the scanner across the document.
- ◆ **Image quality is usually lower.**



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## Drum Scanner

- ◆ Used by the **publishing industry.**
- ◆ Document is placed on a **glass cylinder.**
- ◆ **Generates very high quality scans.**



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## Drum Scanner

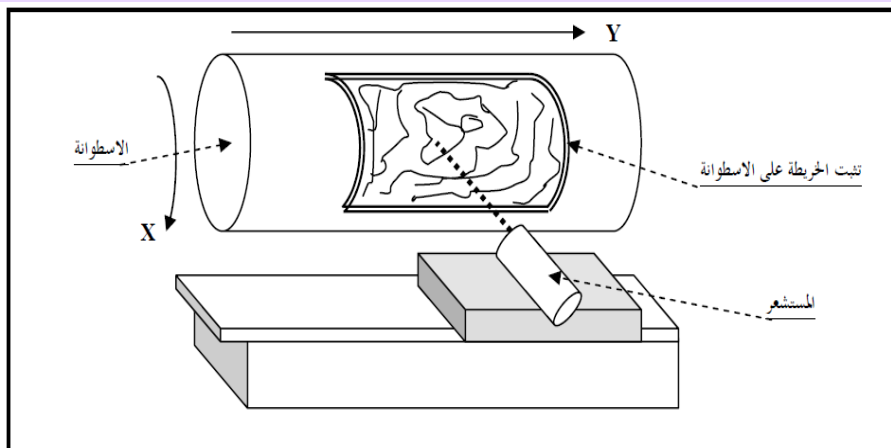


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## Drum Scanner



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## Scanning Formats

- ◆ Depending on your scanning **software**, you may have different options of **file formats** in which to save your scanned image or document.
- ◆ Images may be saved as:
  - ◆ **jpg, bmp, tif, or png.**
- ◆ Documents may be saved as:
  - ◆ **pdf, or any of the image formats**

## 4. Disks

- ◆ **Magnetic storage devices** store data by **magnetizing** particles on a disk or tape. They have a **limited life-span** of 1 to 5 years, depending on the device.
- ◆ **Optical storage devices** store data as **light and dark spots** on the disk surface. They **have an unlimited life-span**.

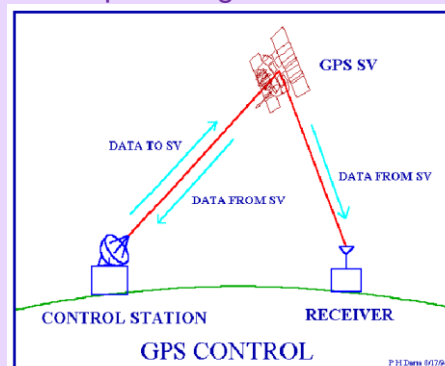


## 5. The Global Positioning System GPS

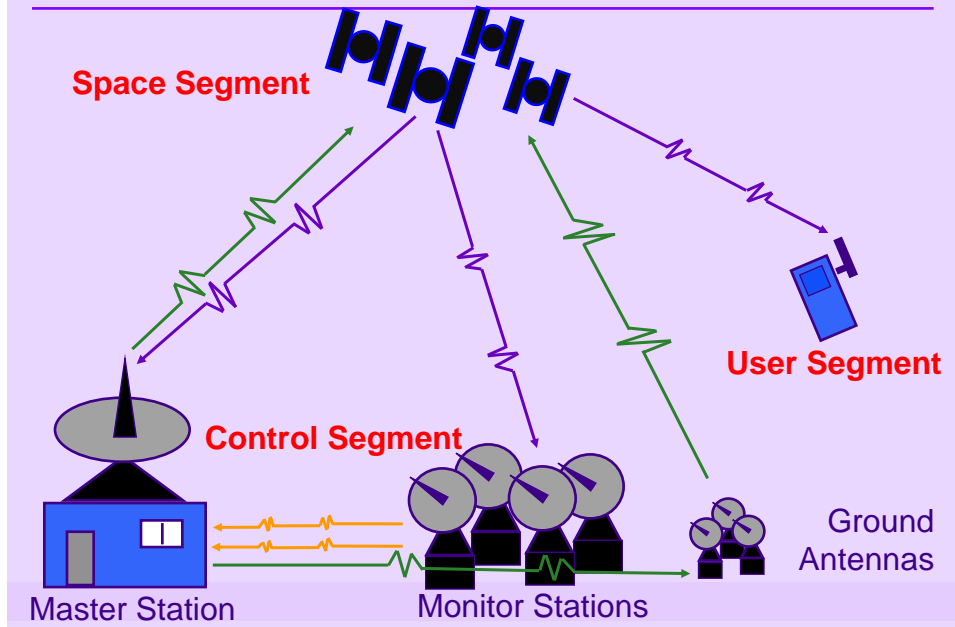
- A tool for determining accurate positions on the surface of the earth
- A satellite-based positioning system available **24/24h** everywhere on the globe with an accuracy better than 100 m.
- Originally designed for navigation and real-time positioning (**meter-level** accuracy): navigation (airplanes, ships, car, missiles, etc...)
- It is **also capable of mm-level accuracy**, with **important** scientific “by-products”.

### Three “segments”

- 1. The space segment= satellites:** Broadcast radio signals toward users on the Earth–Receive commands from the ground.
- 2. The control segment:** monitors the space segment and send commands to satellites.
- 3. The user segment:** receivers record and interpret the radio signals broadcast by the satellites



## Three Segments of the GPS



## 6. Total station

### ◆ Comprehensive cadastral station:

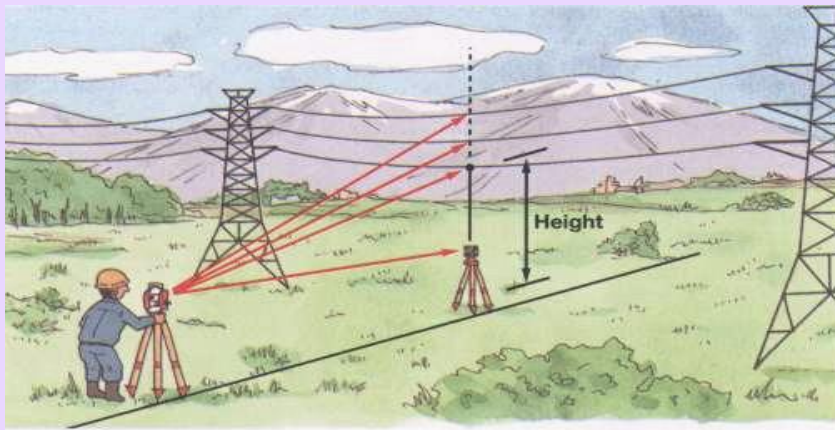
Measuring **distances**, **directions** (Angles) and measure the **elevation**.



## Functions of T.S:

1. **Measures** angles & distances and Record
2. **Computing** the point elevation
3. Computing the **coordinates** of every point
4. Remote **elevation** measurement
5. Remote **distance** measurement
6. Area **calculations**

## REM Remote Elevation Measurement



## Application of Total station:

1. Updating **mapping**
2. Topographic **survey**
3. **Hydrographic** survey
4. **Cadastral** survey
5. Project **construction** survey
6. **Road, Rail** Survey
7. **Mining** survey



## 7. Light pen

- It is a device used for **drawing** pictures and for directly **controlling** screen operations.
- It is a **flat, rectangular electronic** plastic board .
- One use: architects, map **makers**, artists, and **designers** create drawings and sketches using it



## 8. Digital Camera

- ◆ **Digital Cameras** are input devices that allow users to create pictures and/or movies in a digital format.
- ◆ It is a **high-resolution** camera, which captures images and stores them in digital format.
- ◆ It has provision to connect to the computer using special computer communication cables (such as USB cables).



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## 9. Digitizer

**Digitizing** is the process where **features on a map or image** are **converted into digital format** for use by a GIS.



Digitizer Tablet



Digitizer

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## 9. Digitizer

- ◆ Tablet digitizing requires a **person** to enter coordinate information through the use of a *digitizing tablet* and *digitizing puck*
  - ◆ A digitizing tablet is a **hardened surface with a fine electrical wire grid** under the surface.
  - ◆ A digitizing puck is an **electrical device with cross hairs** and multiple buttons to perform data entry operations
  - ◆ An operator then **enters** the information using the puck.



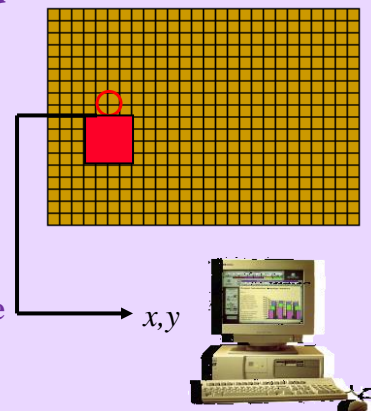
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## Tablet Digitizing – how it works

- ◆ When the user **places the digitizing puck over a location** on the tablet, and presses one of the buttons, the **wire mesh** beneath the tablet **records** the location of the puck.
- ◆ Digitizing tablets are **very accurate**, with more expensive tablets able to measure objects to within **0.006 mm**.
- ◆ The **coordinate**, as referenced by the tablet is then **stored** in the computer.



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## 9. Digitizer

- ◆ Digitizing table
  - 10" x 10" to 80" x 60"
  - \$50 - \$2,000
  - 1/100<sup>th</sup> inch accuracy



- ◆ Puck with control buttons



## The Digitizing Procedure

- ◆ **Affixing** the map to the digitizer
- ◆ **Registering** the map
- ◆ **Actual digitizing**
  - ◆ In **point** mode
  - ◆ In **stream** mode

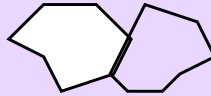
## Errors From Digitizing

◆ **Boredom**

◆ **Map complexity**

◆ ½ hour to 3 days for a single map sheet

◆ **Sliver polygons**



◆ **Wrongly placed labels**

5		6 7	8
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◆ **Error rates depend on the complexity of the map, are high for small scale, complex maps**

## 10. Touch Screens

- It is a display device, which is **touch-sensitive** and allows user to **interact** with the computer system by touching an area on the screen.

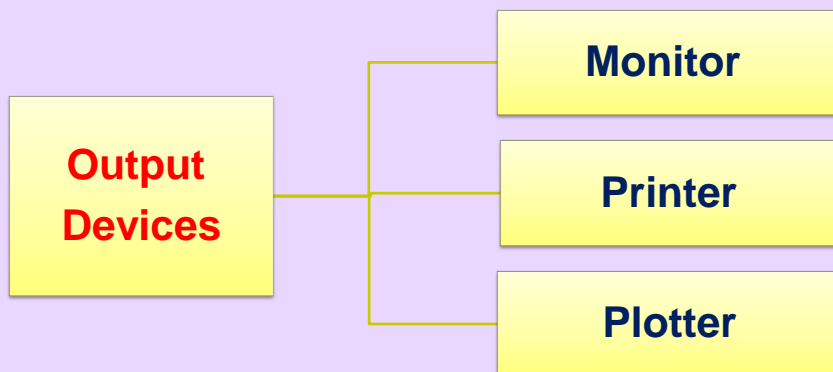


## 11. Bar Code Reader

- ◆ It is used to **accept** barcode inputs.
- ◆ A barcode is a **series of vertical bars representing numbers and alphabets printed on product labels**. One must have noticed all standard items like greeting cards, books, cassettes available in the market have similar lines.
- ◆ These can be read with the help of **bar code readers**.



## Data Output Units



## Monitor

◆ A Monitor is an output device, **very similar to the television screen but usually display information at a much higher resolution.** It displays the information as it is typed and also displays the processed result or the output. It is available in many **forms:**

1. **Cathode ray picture tube based display (CRD),**
2. **Liquid crystal based display(LCD),**
3. **Plasma panel display, and**
4. **Touch panel display.**

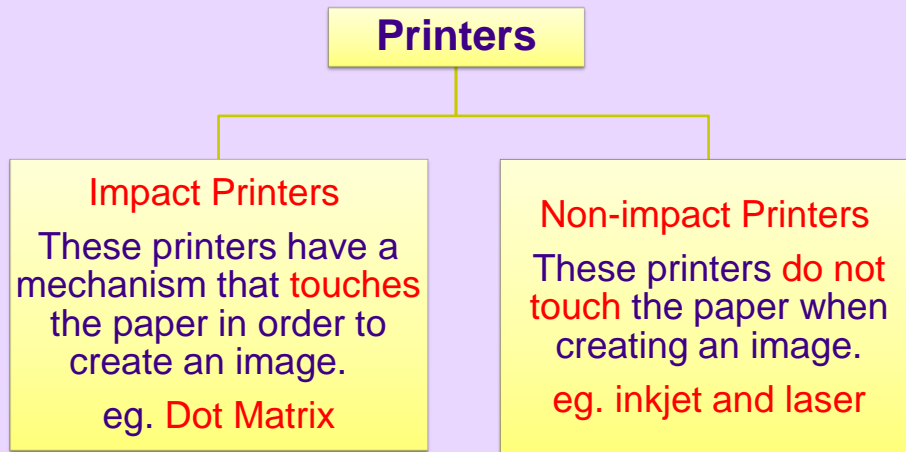
## Printer

◆ It is an output device to **produce** paper copy (**hard copy**) for a document, pictures etc. The job of a printer is to **put** on paper what is seen on the monitor. Printers **vary** mainly in **cost, quality, speed** and **noise** levels eg:

1. **Dot Matrix Printer,**
2. **Inkjet / Deskjet / Bubblejet Printer**
3. **Laser Printer.**



# Printers



## Dot Matrix Printer

- ◆ very **economic** and require **very less maintenance** cost.
- ◆ The print **quality** is decided by the **quantity of pins** it has.
- ◆ The number of the pins can **vary from nine to twenty four**.
- ◆ **Not expensive** compared to the other kind of printers.
- ◆ Make a lot of **noise** when compared to the other kinds of printers.
- ◆ **Quality is not very high** but is highly suitable for printing situations requiring multiple copies.



## Inkjet / Deskjet / Bubblejet Printer

- ◆ This category is most **popular**.
- ◆ These printers are **very low priced with high maintenance cost**.
- ◆ Work on **liquid ink** technology.
- ◆ An inkjet **sprays** the ink onto the paper to form text and graphics.
- ◆ **Speed is not very high** compared to Laser Printers.
- ◆ Suitable for people **having less printing** jobs with a desirable print quality.
- ◆ Available in '**Coloured**' and '**Black & White**' options.



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## Laser Printer

- ◆ These printers use a technique, which is a **combination of laser and Xerox technology**.
- ◆ The technology involves **dry powder based ink**, which is adhered **to a drum through magnetic force**, and when a paper is passed through the drum it releases ink on that paper.
- ◆ These are the **fastest** available printers in the category and are most **suitable** for uses involving **high-speed** quality prints.



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# Plotter

- ◆ A plotter is a **printer** that uses a **pen that moves** over a large revolving sheet of paper.



- ◆ It is used in **engineering, drafting, map making**.
- ◆ Plotters are **expensive** output devices specially designed to produce outputs of diagrams, illustrations and other graphics.

# Plotter

- ◆ There are three different types of plotter:
  1. **Flatbed plotters** - These **hold** the paper still while the pens move
  2. **Drum plotters** - These **roll** the paper over a **cylinder**
  3. **Pinch-roller plotters** - These are a **mixture** of the two types above

## Drum & Flatbed Plotters

### Advantages

1. Drawings are of the same **quality** as if an expert drew them
2. **Larger sizes of paper** can be used than most printers can manage

### Disadvantages

1. Plotters are **slower** than printers because **each line is drawn separately**
1. They are often more **expensive** than printers
3. They do not produce **very high quality text** printouts



## Drum & Flatbed Plotters

- Plotters are a specialist type of printer which is able to draw high quality images on very large pieces of paper, for example **3 foot wide by 10 foot long**.
- They are used by engineers, architects and **map-makers** to draw plans of buildings, diagrams of machines or large scale maps.

## Drum & Flatbed Plotters

- A plotter differs from a printer in that it draws images using a pen that can be lowered, raised and moved across the paper to form continuous lines. The electronically controlled pen is moved around the paper by computer controlled motors.

## Drum & Flatbed Plotters



**Flatbed Plotter**

**A flatbed plotter** is a graphics output device that draws by moving a pen in both horizontal and vertical directions over a sheet of paper; the overall size of the drawing is limited by the height and width of this bed.

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**THANK YOU SO MUCH**