جامعة المستقبل
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Lecture: (2)

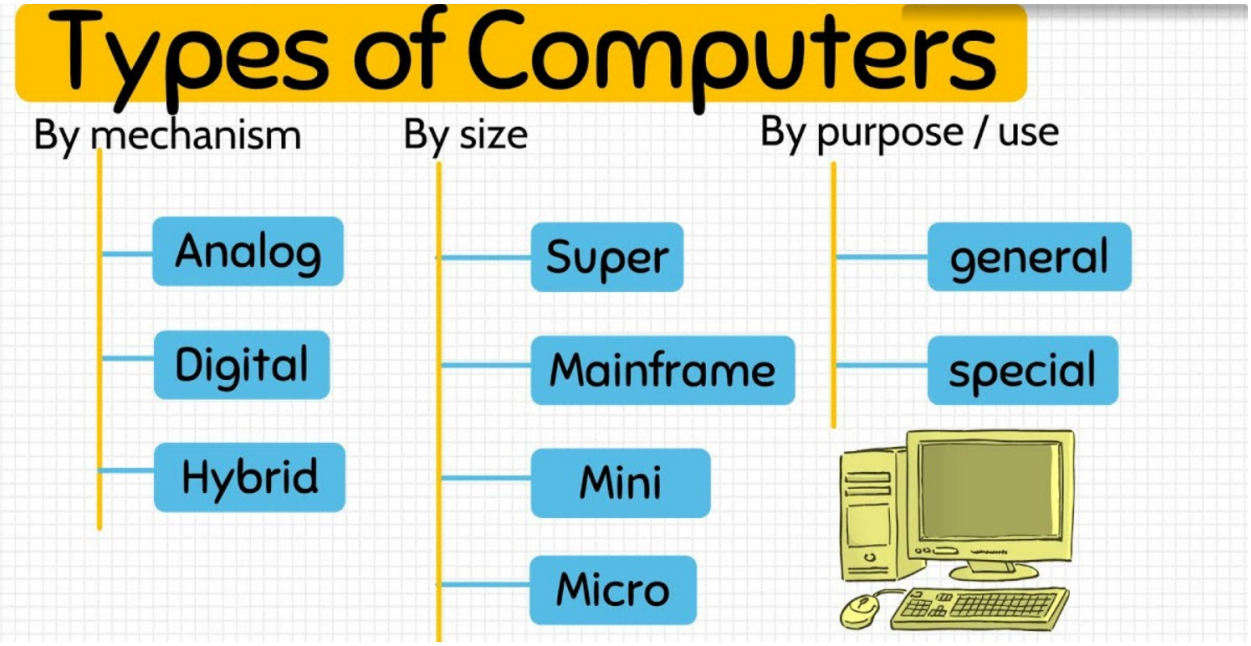
Computer classification [analoge, digital, hybrid]
Main parts of a personal computer, Hardware: the structure of computer system
Input units, Output units

Subject: COMPUTER ORGANIZATION AND LOGIC DESIGN

Class: First

Lecturer: Dr. Maytham N. Meqdad

Computer classification [Analoge, Digital, Hybrid]

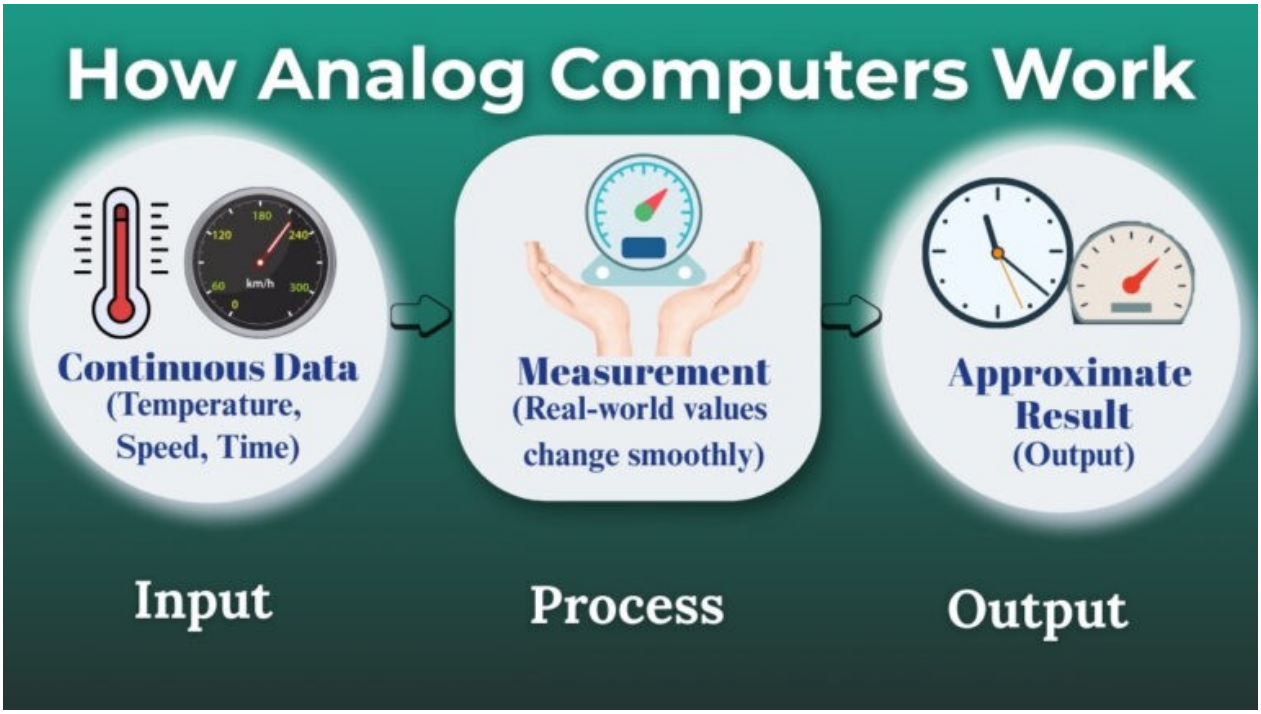


Analog, Digital, and Hybrid Computers

Computers are primarily categorized into three types: **analog, digital, and hybrid computers**. Each type processes data differently and is suited for particular tasks or applications. Understanding their differences provides insight into their role in computing and everyday life.

Analog Computers

Analog computers work with **continuous data** and measure physical quantities such as temperature, speed, or pressure. These computers excel in tasks that require real-time simulations or measurements, though they are limited in versatility compared to digital computers.



Characteristics of Analog Computers

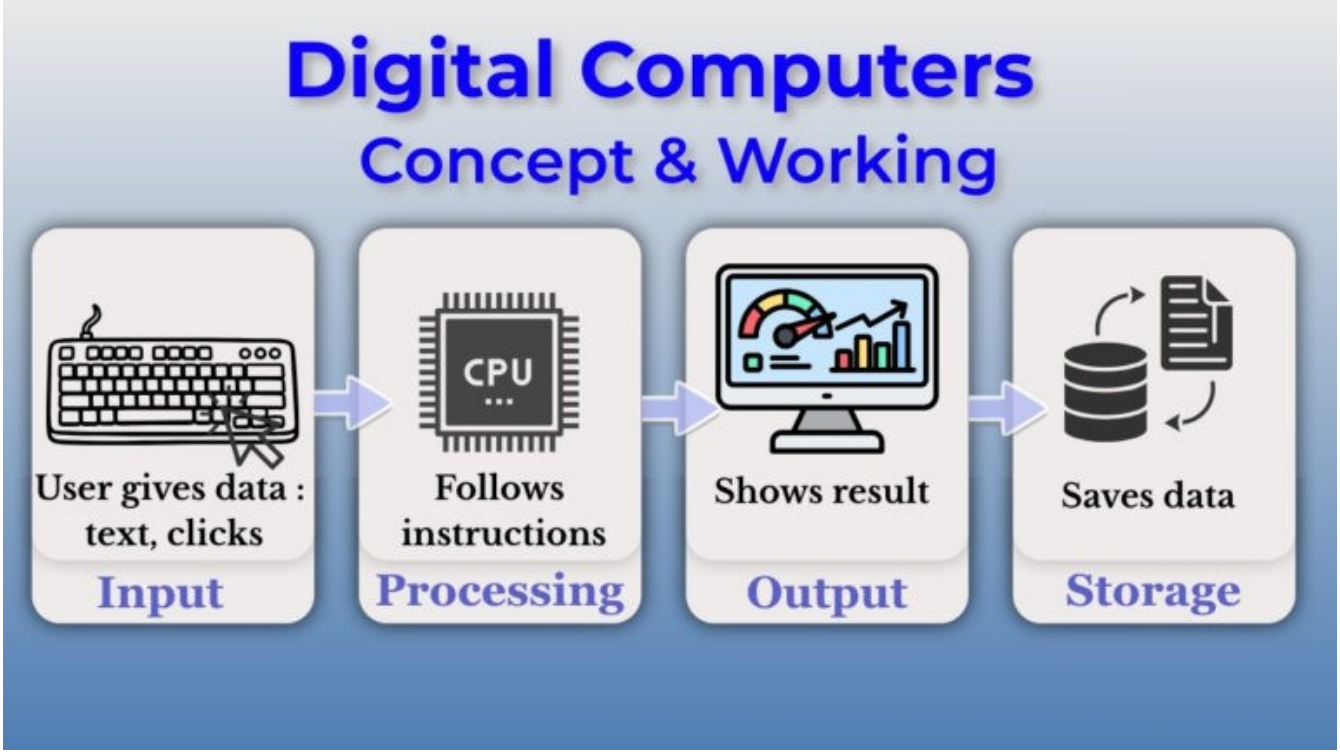
1. **Data Processing**: Handles continuous data in physical form, like voltage or mechanical motion.
2. **Applications**: Commonly used for simulations, measurements, and tasks such as plotting trajectories or studying physical processes.
3. **Precision**: Less precise than digital computers due to the continuous nature of their data.

Everyday Examples of Analog Computers

- **Old-fashioned thermometers**: Measure temperature using the expansion of liquid mercury.
- **Analog speedometers**: Display vehicle speed using continuous motion of the needle.

Digital Computers

Digital computers process **discrete data** using binary (0s and 1s). They are the most versatile and commonly used computers today, suitable for a wide range of tasks, from basic calculations to complex simulations.



Characteristics of Digital Computers

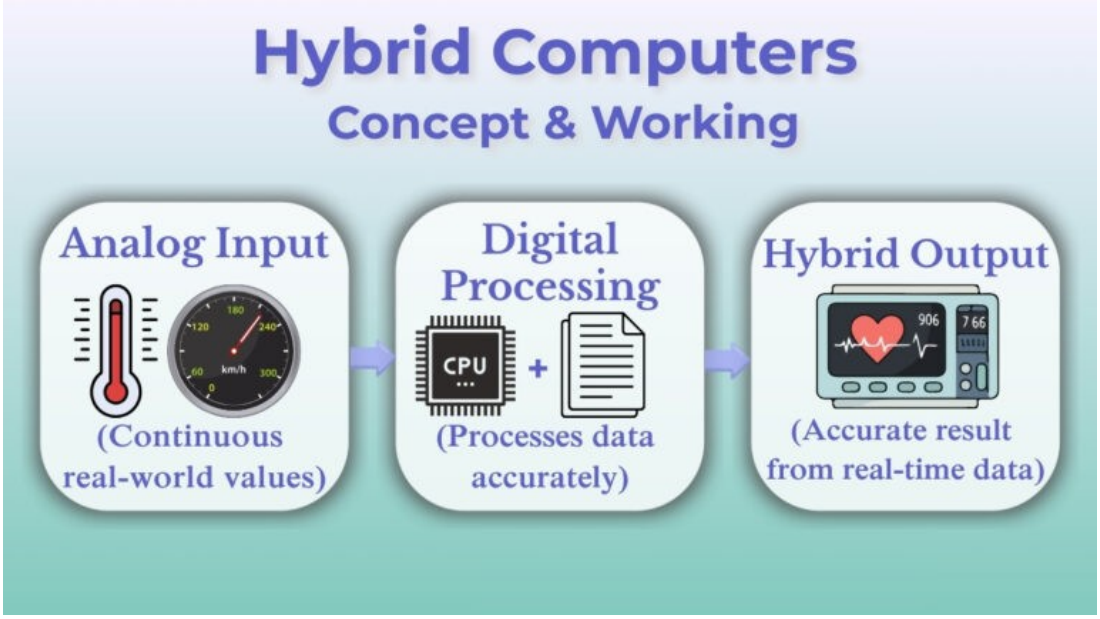
1. **Data Processing**: Operates using binary data and handles discrete values.
2. **Applications**: Used for general-purpose tasks like browsing the internet, creating documents, and video editing.
3. **Precision**: Highly accurate and consistent due to binary processing.

Everyday Examples of Digital Computers

- **Modern laptops/desktops**: Enable tasks like computing, word processing, and internet browsing.
- **Digital thermometers**: Display temperature as discrete numeric data on a screen.

Hybrid Computers

Hybrid computers combine the **speed of analog systems** with the **accuracy of digital systems**. These specialized computers process both continuous and discrete data, making them ideal for applications requiring real-time tracking combined with precise digital computations.



Characteristics of Hybrid Computers

1. **Data Processing**: Merges continuous analog signals with discrete digital data.
2. **Applications**: Commonly found in specialized fields like healthcare, research, and weather forecasting.
3. **Precision and Speed**: Offers analog real-time data capture with digital processing for accuracy.

Everyday Examples of Hybrid Computers

- **Medical monitoring systems**: Measure physical phenomena like heart rate (analog data) and display it digitally.
- **Advanced weather forecasting systems**: Measure environmental data (e.g., wind speed) and analyze it digitally for precise predictions.

Key Differences Between Analog, Digital, and Hybrid Computers

Aspect	Analog Computers	Digital Computers	Hybrid Computers
Nature of Data	Continuous (e.g., temperature, speed)	Discrete (binary or numeric data)	Combination of continuous and discrete data
Applications	Real-time simulations and measurements	General-purpose computing tasks	Applications requiring accuracy and real-time speed
Speed	Fast for real-time tasks	Relatively slower than analog	Combines real-time speed with digital precision
Precision	Less precise due to analog limitations	High precision and consistent results	Hybrid of analog speed and digital accuracy
Examples	Thermometers, mechanical speedometers	Laptops, smartphones, digital thermometers	Medical monitors, weather forecasting systems, industrial controllers

Choosing the Right Type of Computer

The purpose of use determines which type of computer is best suited:

- **Analog Computers**: Best for real-time simulations and physical measurements, such as in engineering and research applications.
- **Digital Computers**: Ideal for precise, versatile, and everyday tasks like browsing, calculations, and software development.
- **Hybrid Computers**: Perfect for specialized fields like healthcare, meteorology, or industries requiring real-time data analysis with high accuracy.

What is Hybrid Computer?

A hybrid computer is a special type of computer that combines analog and digital features. It can process data quickly like a digital computer and measure real-world values like an analog computer. This makes it useful in hospitals, weather forecasting, and scientific research. For example, doctors use hybrid computers to monitor heartbeats and store patient records at the same time. These computers are powerful because they provide both speed and accuracy in one system.

How Do Hybrid Computers Work?

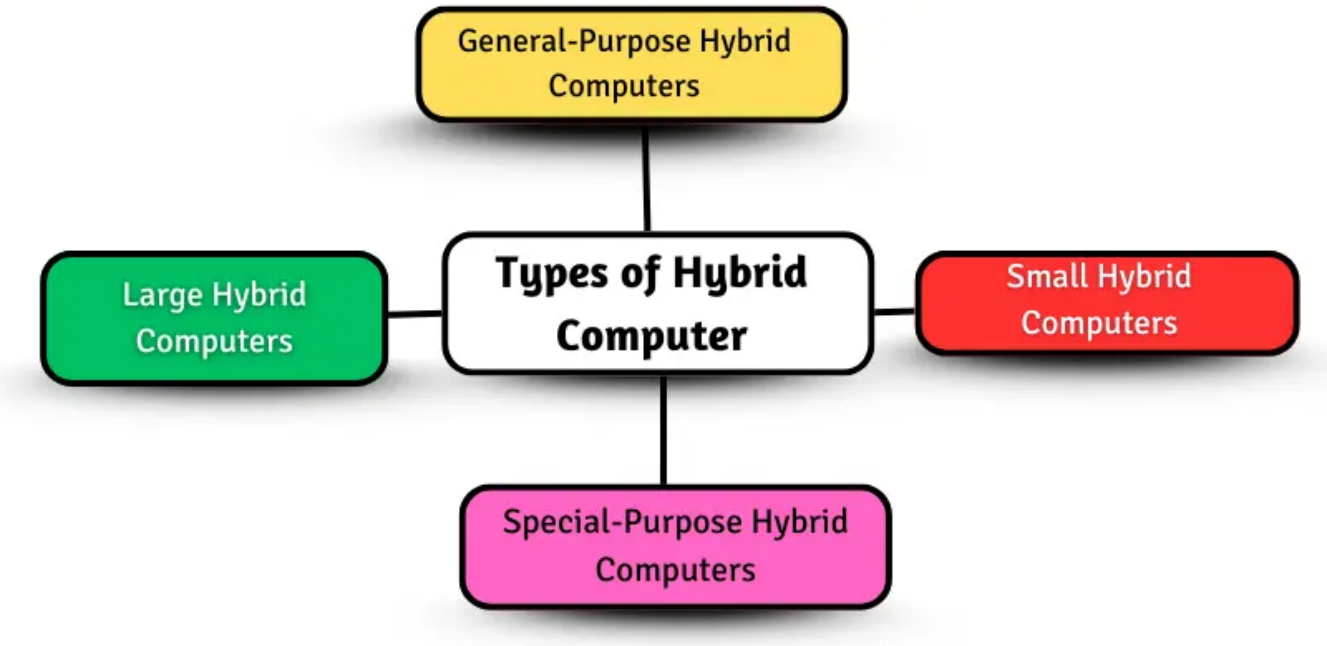
Hybrid computers use the analog part to handle real-time, continuous data and the digital part to perform precise calculations.

Working Steps:

1. **Collect Data (Analog):** Gathers real-time data from sensors, such as temperature or pressure.
2. **Convert to Digital:** Analog data is transformed into digital form using an Analog-to-Digital Converter (ADC).
3. **Process Data (Digital):** Performs binary calculations and analysis (0s and 1s).
4. **Combine Results:** Merges analog and digital results for accurate output.
5. **Output:** Displays the processed data or uses it to control systems.

Types of Hybrid Computers

There are different types of hybrid computers based on their **features and uses**. Each type uniquely combines **digital and analog functions** to perform specific tasks.



Main Types of Hybrid Computers:

1. General-Purpose Hybrid Computers
2. Special-Purpose Hybrid Computers
3. Large Hybrid Computers
4. Small Hybrid Computers

General-Purpose Hybrid Computers

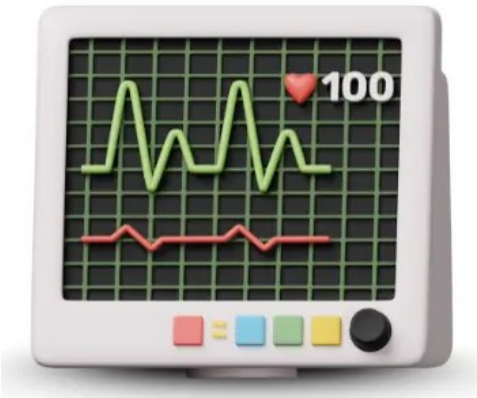
These computers can do many different tasks by using both real-time data collection (analog) and calculations (digital).

Features:

- Versatile and flexible.
- Can handle multiple tasks at once.
- Used in medical and scientific fields.

Examples:

- **ECG Machines**: Monitor heartbeats in hospitals.
- **Scientific Instruments**: collect data and process it for research.



General-Purpose Hybrid Computers

Special-Purpose Hybrid Computers

Built for specific jobs like controlling machines or running simulations. They combine real-time data collection and digital calculations for specific tasks.

Features:

- Optimised for one particular job.
- Combines analog and digital for better results.

Examples:

- **Flight Simulators**: Real-time control data helps pilots train in lifelike conditions.
- **Space Equipment**: Used for analyzing space data and controlling spacecraft.

Large Hybrid Computers

These powerful systems are used for big tasks like weather forecasting, and they can process a lot of data at once using both analog and digital features.

Features:

- High performance for complex tasks.
- It can handle huge amounts of data in real time.

Examples:

- **Weather Forecasting Systems**: Collect real-time weather data from satellites and process it for accurate forecasts.
- **Scientific Research**: Used in labs for processing data and running large simulations.

Small Hybrid Computers

These hybrid computers are small but powerful in portable devices like medical equipment or robots.

Features:

- Compact and portable.
- Efficient for tasks that need real-time data and digital calculations.

Examples:

- **Portable ECG Monitors**: Keep track of heart rate on the go.
- **Robots**: Process sensor data and control robot movements in real-time.

Uses of Hybrid Computers

Hybrid computers are used in a wide range of fields where both speed and accuracy are crucial. They combine the advantages of digital and analog computing to perform complex tasks efficiently. Here are some common uses of hybrid computers:

- **Medical Field**: Used in medical equipment to monitor real-time data, such as heart rate, while storing patient records.
- **Weather Forecasting**: Helps predict weather by processing real-time data and analyzing historical information.
- **Industrial Automation**: Controls machines and monitors factory operations by combining analog data and digital control systems.
- **Scientific Research**: Assists in experiments requiring precise calculations and real-time data analysis.
- **Space Exploration**: Used in space missions to analyze space data and control spacecraft systems.
- **Robotics**: Helps control robotic movements and processes real-time sensor data for accurate actions.

Advantages and disadvantages of hybrid computers

Hybrid computers offer a mix of benefits, combining both speed and accuracy for a wide range of tasks. However, they also have some limitations that can affect their performance in certain situations.

Advantages

- Combines speed and accuracy.
- Handles real-time and complex tasks.
- Reduces errors with digital and analog functions.
- It saves time by doing multiple jobs at once.
- Improves decision-making with precise results.
- Suitable for large-scale applications.
- Supports fast processing and precise data.
- Useful in critical fields like healthcare.
- Provides reliable performance in tough conditions.
- Helps in scientific and space research.

disadvantages

- It can be expensive.
- Complex to set up and operate.
- Requires skilled operators.
- Bulky and large in size.
- Not needed for simple tasks.
- Maintenance can be costly.
- It may need extra power to run.
- Not always energy-efficient.
- Difficult to upgrade.
- It can be slower for basic operations.

Main parts of a personal computer, Hardware: the structure of computer system Input units, Output units

Main parts of a personal computer

The **main parts of a Personal Computer (PC)** are the basic hardware components that allow the computer to work properly. They are usually divided into several key parts:

1. Central Processing Unit (CPU)

- It is the **brain of the computer**.
- Executes instructions and processes data.
- Controls all operations inside the computer.

2. Motherboard

- The **main circuit board** of the computer.
- Connects all components such as CPU, memory, storage, and peripherals.

3. Random Access Memory (RAM)

- Temporary memory used while programs are running.
- Stores data that the CPU needs quickly.
- Data in RAM is **lost when the computer is turned off**.

4. Storage Devices

- Used to store data permanently.
- Examples include:
  - **Hard Disk Drive (HDD)**
  - **Solid State Drive (SSD)**

5. Input Devices

- Used to **enter data into the computer**.
- Examples:
  - Keyboard
  - Mouse

- Scanner
- Microphone

6. Output Devices

- Used to **display or produce results** from the computer.
- Examples:
  - Monitor
  - Printer
  - Speakers

7. Power Supply Unit (PSU)

- Provides electrical power to all internal components of the computer.

8. Computer Case (System Unit)

- The physical box that **contains and protects the internal components**.

Input Devices

Input devices are hardware components used to **enter data and instructions into the computer**.

some input devices:

- **Keyboard:** The most widely used input device, featuring 104 keys, including alphabetic, numeric, and function keys. Modern keyboards connect via Bluetooth, replacing traditional wired connections.
- **Mouse:** A pointing device that controls the cursor on the screen. It features left, right, and middle buttons for selection and interaction. The sensor inside the mouse detects its movement speed, adjusting the cursor accordingly.
- **Scanner:** Scans documents, images, and other media, converting them into digital formats for editing or processing, similar to a Xerox machine.

- **Trackball:** A stationary pointing device with a ball that the user rotates to control the cursor, requiring less space than a traditional mouse.
- **Light Pen:** A light-sensitive pen used to draw or select objects on a CRT screen by detecting raster patterns, offering a direct interaction with the display.
- **Microphone:** Converts sound into electrical signals. It captures voice input for speech recognition and voice commands on the computer.
- **Optical Character Reader (OCR):** Scans printed or handwritten text, converting it into digital data by detecting reflected light from the characters, similar to a scanner.
- **Bar Code Reader:** Reads bar codes and converts them into digital data for processing. The bar code consists of light and dark lines that encode information.

Output Devices

Output devices are hardware components used to **display or produce results from the computer after processing**.

some common output devices:

- **Monitor:** The main output device. It is also called VDU(visual display unit) and it looks like a TV screen. The Monitor displays the information from the computer. It is used to display text, video, images, etc.
- **Printer:** A printer is an output device that transfers data from the computer in a printed format by using text or images on paper. There are both coloured and black & white printers. Further, there are also different types of printers, like Laser Printer, Dot-matrix printers, and Inkjet printers.
- **Plotter:** It is similar to a printer but potters are large. A plotter is used to generate large drawings, architectural blueprints, etc. on paper and these are high-quality images and drawings and large.

- **Speakers:** It is a very common output device and it gives sound as an output. The speaker is generally used to play music or anything having sound.

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