OUTPUT DEVICES

Lecture 10

Input Device

Processor-
Central processing
Unit (CPU)

Output Device

Storage Device

Topics Covered in Last Lecture

- Input Devices
  - Learning Objectives
  - Input Devices and Their Uses
    - Manual Input Devices and their Uses
    - Sensors
  - Direct Data Entry (DDE) Devices
    - Magnetic Stripe Reader
    - Contactless Debit Card Readers
    - Chip and PIN Reader
    - Radio Frequency Identification(RFID) Readers
    - Optical Mark Recognition/Reader (OMR)
    - Optical Character Recognition(OCR)
    - Barcode Readers/Scanners
    - Quick Response (QR) Code Scanners (Readers)

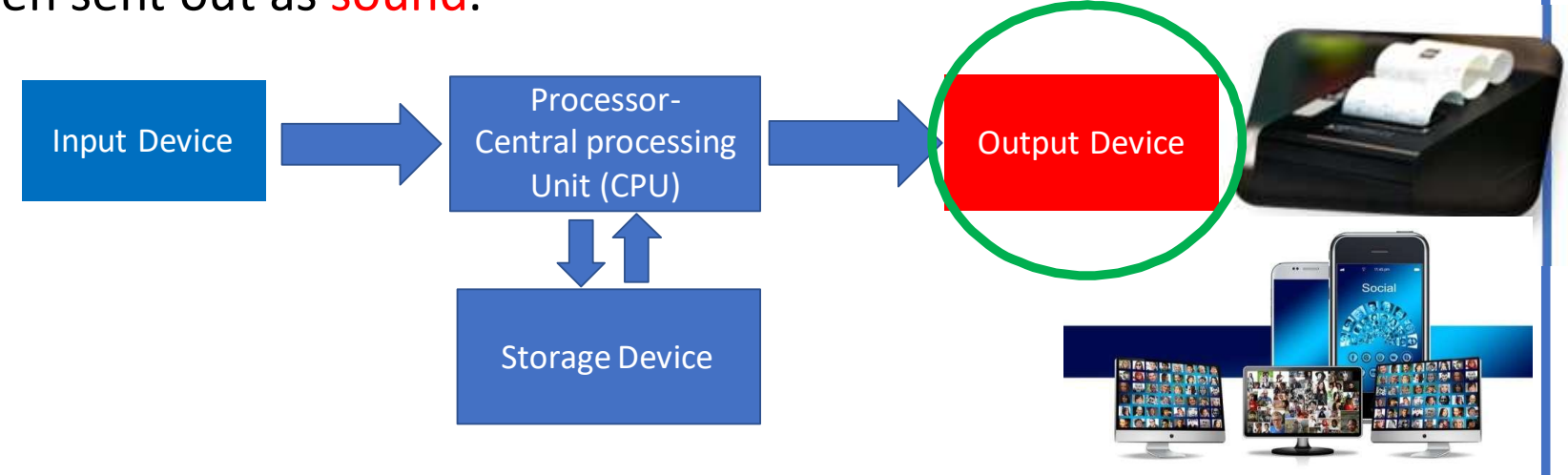
Today's Topics

- Output Devices and Their Uses
  - Cathode Ray Tube (CRT) Monitor
  - LED Screens
  - LCD Screens
  - Touchscreens
  - Multimedia Projectors
  - Laser Printers
  - Inkjet and Dot Matrix Printers
  - Plotters and 3D Printers
  - Speakers
  - Actuators

Understand different characteristics of Output Devices (like monitors, projectors, printers etc.), their uses, advantages, and disadvantages.

Output devices and their uses

- Output devices help us see processed information from a computer
- This information can be displayed on monitors, printed on paper, or even sent out as sound.



Output Devices and their uses

Monitors (Screens)

Cathode Ray Tube (CRT) monitor

- They are the least expensive type of monitors.
- Mostly used as large screens in specialized areas for Computer-aided design (CAD).

Advantages of CRT monitors	Disadvantages of CRT monitors
▪ Screen has a wider range of viewing angles than most LCD monitors ▪ Allow use of light pens for CAD/CAM applications	▪ Bulky and heavy compared to most LCD screens ▪ They can flicker leading to headaches and eyestrain ▪ Consumes more power than LCD monitors

Monitors (Screens)

LED screens

- Made up of tiny light emitting diodes (LEDs) in red, green or blue use to produce a vast range of onscreen colours by varying the electric current sent to each LED.
- Used for large outdoor displays due to their good quality of colours produced.

Output Devices and their uses

Monitors (Screens)

LCD screens

- LCD screens use LED technology for backlighting by employing a matrix of tiny blue-white LEDs behind the LCD screen.
- LEDs are more widely used now instead of Cold Cathode Fluorescent (CCFL) technology due to the following superior advantages of LEDs;
  - ✓LEDs produce brighter light which gives better colour definition
  - ✓LED screens are much thinner compared to screens using CCFL
  - ✓LEDs can reach their maximum brightness within a few seconds
  - ✓LEDs screens consume less energy compared to CCFL screens.

LCD
cold cathode fluorescent

LED Backlight

Output Devices and their uses
Monitors (Screens)

LCD screens cont….

- LCD screens are used for display on computers, smartphones, laptop and tablets.

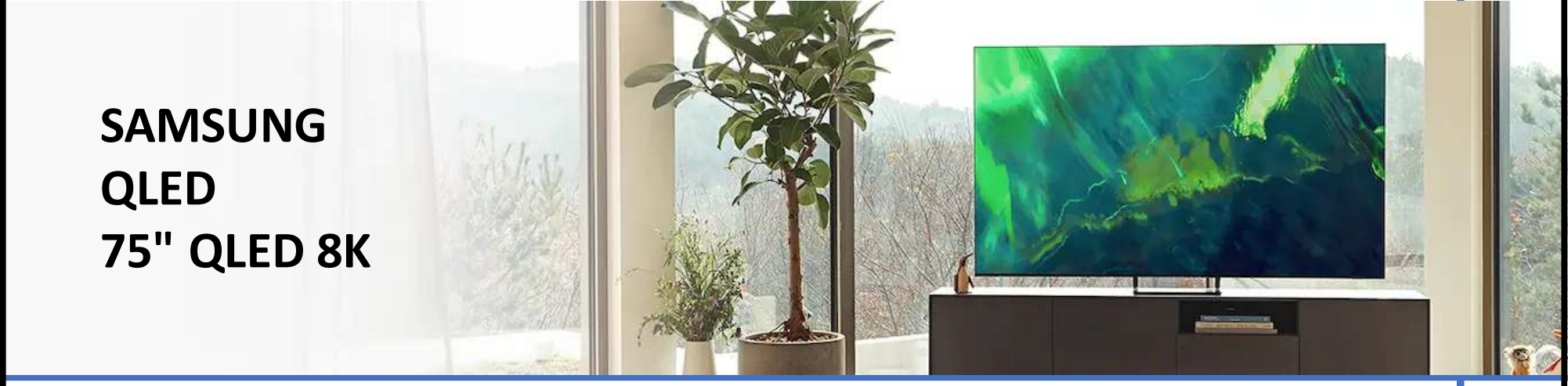
Advantages of LCD monitors	**Disadvantages of LCD monitors**
▪They are very efficient and consume less energy ▪ Lightweight compared to CRTs ▪ Do not suffer from flickering screens as in CRTs ▪ Produce very good image resolutions in many colours	▪Limited viewing angles with colour inconsistencies ▪It is harder to produce deep, rich black colour, leading to lower contrast than in CRT monitors. ▪ Motion blur is very common in LCD screens

Output Devices and their uses
Monitors (Screens)

QLED stands for Quantum Dot LED, meaning that there is an extra layer of nanocrystals between the LED lights and the viewing screen.

Quantum Dot LEDs (QLEDs) use quantum dots to enhance the color and efficiency of light emission.

SAMSUNG
QLED
75" QLED 8K



Output Devices and their uses
Monitors (Screens)

OLED (Organic LED) (sometimes referred to as W-OLED, White OLED) panels are made up of a carbon-based organic compound sandwiched between two electrodes.

When an electrical current is passed through these layers, they emit a white light, which is then passed through an RGB colour filter to make a picture – and part of what makes OLED so good is that this is all possible on a pixel-by-pixel basis.

42-inch Class LG OLED Flex
4K Smart TV - 42LX3QPUA

Output Devices and their uses

Monitors (Screens)

Touchscreens

- Touch screens serve as both an input and output device.
- Used in: smartphones and tablets
- ATMs at banks for selecting and entering options
- Ticket collection machines in cinemas, railway stations...

Advantages of touch screens	Disadvantages of touch screens
▪ Faster and error free method for entering options ▪ User friendly method in most cases.	▪ Limited options to select from ▪ Not good for large amounts of data entry ▪ Screen can get very dirty especially public ATMs

Output Devices and their uses

Multimedia projectors

- Receives analogue or digital signal inputs from a computer or DVD player and a magnified image is projected onto a large screen.
- Use for presentations during training, classroom, advertisement, cinemas etc.

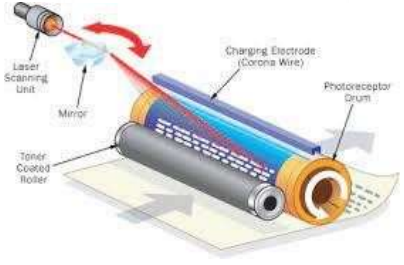
Advantages of projectors	Disadvantages of projectors
▪Provides better screen (presentation) size for a larger audience compared to a small computer screen. ▪ Larger viewing angle	▪ Expensive to buy ▪ Images can sometimes be fuzzy.

Output Devices and their uses

Printers

Laser printers

- Makes use of laser light to create character/images which are printed onto paper.
- Used where low noise is required; offices, libraries, schools etc.
- Ideal printer for high-quality, high-volume printouts.



Advantages of laser printers	Disadvantages of laser printers
▪ Faster printouts; quick print rates ▪ Can handle very large printout jobs; printing press. ▪ Produces consistently high quality outputs	▪ Only fast when large printout copies are made ▪ Colour laser printers are more expensive to run ▪ Can lead to health hazards; produces ozone and other organic compounds during printing.

Output Devices and their uses

Printers

- **Inkjet and Dot Matrix Printers**

Printer	Description/Use	Advantages	Disadvantges
Inkjet printers 	▪ Droplets of ink are sprayed on paper to make characters ▪ Ideal printer for high quality low-volume printouts (just a few pages)	▪ High quality output ▪ Cheaper to buy than laser printers ▪ Do not produce ozone and other harmful gases	▪ Output is slow for large volume printouts ▪ Expensive to run ▪ ink runs out quickly
Dot matrix printer 	▪ A type of impact printer ▪ Still used for continuous rolls on paper printouts and till receipt. ▪ Useful for printing in noisy and dirty environments	▪ Can be used in dusty or moist environments ▪ Very cheap to run and maintain ▪ Easy to use especially for long print jobs	▪ They are very noisy and slow ▪ They might cost more than inkjet to buy

Output Devices and their uses

Plotters and 3D Printers

Output device	Description/Use	Advantages	Disadvantges
Plotter 	▪ Used with CAD and CAM systems ▪Used for producing architectural drawings, engineering drawings and animation characters.	▪ Very High quality output ▪ Produces large accurate colour drawings ▪Can print on a variety of materials	▪ Very slow printing method ▪ Expensive equipment and accessories
3D printers 	▪ Primarily used in CAD applications ▪Used to produce solid 3D object that actually work ▪ Used in manufacturing industries etc.	▪ Much easier manufacturing of items ▪Rapid prototyping is possible with 3D printers ▪Can be used in medical facilities for prosthetics and reconstruction surgery	▪Potential job losses especially in manufacturing and construction ▪In the wrong hands, the technology can be used for counterfeiting, dangerous or illegal activities

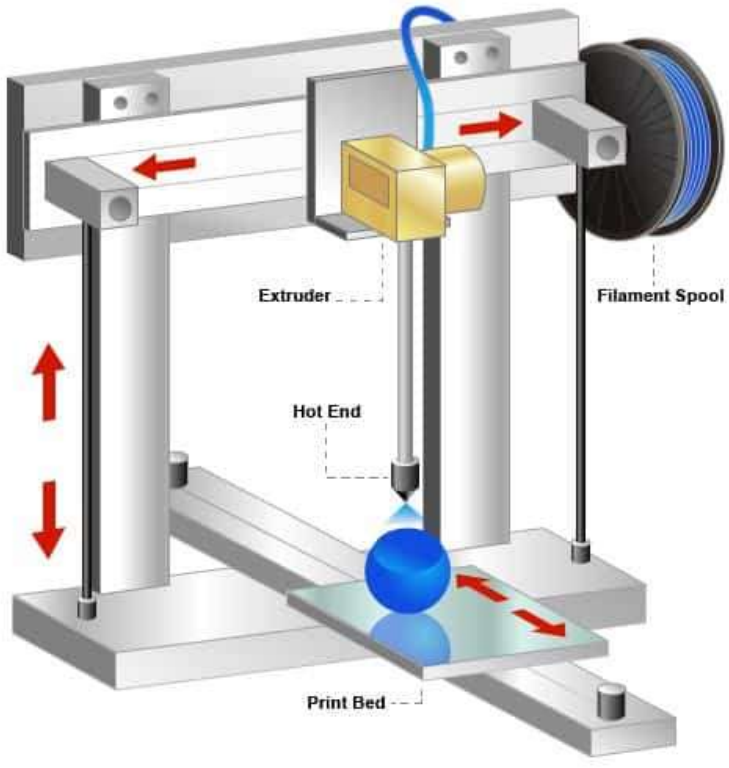
Output Devices and their uses

3D Printers

3D printing is a process that uses specialized equipment and computer-aided design (CAD) to create solid three-dimensional objects, layer by layer from a digital file.

Common Usage:
Aerospace, Automotive, Healthcare

It’s mostly used for prototyping.



Output Devices and their uses

3D Printers

Output Devices and their uses
AR/VR/MR/XR

AR (Augmented Reality) overlays digital elements (images, text, or sounds) onto the real-world environment via smartphones or glasses.
VR (Virtual Reality) immerses users in a fully virtual, computer-generated environment using a VR headset.
MR (Mixed Reality) blends the real and virtual worlds, allowing physical and digital objects to co-exist and interact in real-time.
XR (Extended Reality) encompasses all real-and-virtual environments generated by computer technology (AR, VR, and MR).

Output Devices and their uses
AR/VR/MR/XR

Input Devices: Motion Controllers, Cameras, Sensors, and Hand-Tracking Systems

Output Devices: Immersive Visual Environment, Spatial Audio System

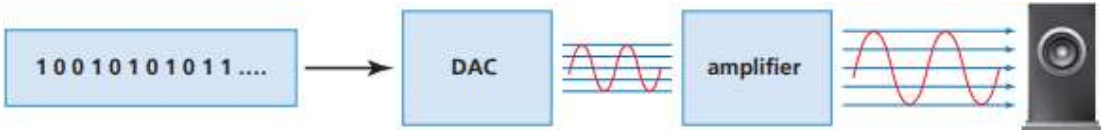
Embedded Systems: Modern standalone headsets like Oculus Quest and HoloLens often include dedicated processors, sensors, and software.

- If focusing on the hardware's functionality in terms of interaction with the user, they are input/output devices.
- If focusing on the system architecture that processes information and operates autonomously, they can be categorized as embedded systems.

Output Devices and their uses

Speakers

- Output devices that produce sound from a digitized sound or from speech through a microphone. Used in phones, laptops, tablets, TVs etc.



Advantages of Speakers	Disadvantages of speakers
▪ Enables output from a computer to be heard by crowd of people ▪ Very helpful for visually impaired persons.	▪ Output from speakers can be disturbing in certain environments such as offices. ▪ Speakers can be very expensive; for high quality sound.

Output Devices and their uses

Actuators

- A mechanical or an electromechanical device such as *relays, motors,* etc. used to activate or deactivate (start/stop) a system controlled by a computer.
- They allow computers to control devices that require analogue inputs.
- E.g: computer control of conveyor belts in factories use actuators.

Advantages of actuators	Disadvantages of actuators
• They allow remote control of many devices. • Relatively cheap to operate	• When the device gets faulty, the system is halted • Computers signals must be converted to analogue using DAC to carry out control of devices.

Output Devices and their uses

Actuators

- Motors: Movements of robotic parts or system components
- Buzzers : Produces noise as an alert
- Light : Alert lights on devices for battery low, fuel low etc.
- Heater: Heat control; mainly increases heat.
- Relay: Turn on or off a device or circuit

Case Study 1: Using 3D Printing in Healthcare

Background:
A hospital in Lahore is working with engineers to design **custom prosthetic limbs** for patients. Traditionally, prosthetics are expensive, take weeks to manufacture, and often need multiple adjustments.

Question:
Which **output device** discussed in this lecture is being used in this case, and why is it more effective than traditional manufacturing methods?

Case Study 1: Using 3D Printing in Healthcare

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Answer:
The output device is a **3D Printer**. Doctors and engineers can now scan a patient's limb, design a digital model, and print a customized prosthetic, With the help of **3D printers,** within a few days at a fraction of the cost.
More effective because:

- Produces customized, patient-specific prosthetics.
- Reduces cost and production time.
- Allows rapid prototyping and adjustments.

Case Study 2: Choosing a Display Tech for a Public Open-Day

Background:

Your university is hosting a 2-hour Open-Day in a bright, glass-walled atrium.

Marketing wants to showcase:

- HDR promo videos, brand colors, and live social feeds
- Content visible to **200+ visitors simultaneously** from various angles
- **No wearables** (hygiene, inclusivity, and logistics)
- **Continuous operation** for several hours with minimal staff support

Two proposals:

- **QLED wall/display** in the atrium
- **AR/VR experience booth** with head-mounted devices

Case Study 2: Choosing a Display Tech for a Public Open-Day

Operational constraints (think & calculate):

- Expected footfall during the 2-hour window: **~300 visitors**
- If AR/VR sessions take **5 minutes** each and you manage **10 headsets**, max throughput ≈
  10 headsets × (60 ÷ 5) sessions/hour × 2 hours = **240 people** (and that ignores 1–2 minutes/device for cleaning & onboarding, which reduces capacity further).
- **Accessibility:** some visitors wear glasses, some avoid headsets; many want to watch together.
- **Environment:** high ambient light; content must be color-accurate and eye-catching from a distance.

Question (single correct answer)

Which technology—**QLED** or **AR/VR**—best satisfies these Open-Day requirements, and why?

Case Study 2: Choosing a Display Tech for a Public Open-Day

Answer: QLED

Why (analysis the students should articulate):

- **Audience scale & inclusivity:** QLED lets **everyone view simultaneously** without headsets; AR/VR is inherently single-user/low-throughput and excludes those unwilling/unable to wear a device.
- **Logistics & hygiene:** QLED needs **no device sanitization, fitting, or staff per user**; AR/VR requires constant cleaning, onboarding, and supervision.
- **Throughput (problem-solving):** Even optimistic AR/VR math falls short (**≤240** users in 2 hours before cleaning delays); QLED supports **all 300** continuously.
- **Environment fit:** QLED displays offer **high brightness and vivid color volume** that remain visible in bright atrium lighting; AR/VR isolates users from the shared event space.
- **Content type:** Marketing videos/brand visuals are **broadcast media**—a large QLED is purpose-built; AR/VR is for **immersive, interactive** use cases, not public passive viewing.

Case Study 2: Choosing a Display Tech for a Public Open-Day

Contemporary comparison (prompting critical thinking):

- **Versus OLED:** OLED excels in dark rooms and perfect blacks; in bright, public spaces, QLED's higher typical brightness and color volume make it more practical.
- **Versus Projectors:** Projectors struggle with ambient light and require controlled conditions; QLED maintains punchy visuals in open atriums.
- **Versus AR/VR:** AR/VR shines in **training/simulation** (surgery drills, lab safety), not in **mass public display** scenarios.

Background:

An engineering design firm specializes in **architectural blueprints** and **mechanical component designs**. The firm needs to produce **large, highly accurate drawings** on physical media to share with clients and construction teams.

The requirements are:

- **High precision** with exact scaling of measurements.
- Ability to print **very large sheets (A1/A0 size)**
- Clear visibility of fine details such as dimensions and curves
- Cost efficiency for repeated use

Case Study 3: Choosing the Right Output Device for an Engineering Design Firm

Background:

The IT department is evaluating the following output devices:

- **Laser Printer**
- **Inkjet Printer**
- **Dot Matrix Printer**
- **Plotter**

Case Study 3: Choosing the Right Output Device for an Engineering Design Firm

Question:

Considering the requirements of the engineering design firm, **which output device should be selected, and why?** Compare the options before giving your final choice

Answer:

When deciding on the best output device for an engineering design firm, the requirements must be carefully analyzed. The firm needs to produce **large, highly precise technical drawings** on physical sheets. This immediately rules out devices that are only suited for everyday document printing or casual use.

Let us compare the options.

Answer:

Laser Printers:

Laser printers are reliable and very efficient for producing office documents, reports, and presentations. They provide fast output and clear text, but they are generally limited to smaller paper sizes such as A4 or A3. They are not designed to produce very large architectural or mechanical drawings, and scaling accuracy can become an issue. Hence, they cannot fulfill the firm's core requirement.

Answer:

Inkjet Printers:

Inkjet printers are capable of printing high-resolution images with excellent color quality. They are often used in graphic design or photography studios. However, when it comes to producing large-scale blueprints, inkjets are not practical. Printing large sheets consumes a lot of ink, making the process expensive for frequent use. In addition, they may not offer the precision and durability required for professional engineering documents.

Answer:

Dot Matrix Printers:

Dot matrix printers are valued in some industries because of their low cost and ability to print multiple copies through carbon paper. However, their output quality is very basic, with low resolution and poor clarity. They are completely unsuitable for tasks that demand exact scaling, fine lines, and clear details, as required in engineering drawings.

Answer:

Plotters:

Plotters are specifically designed for technical and engineering applications. They can print on **large sheets (A1/A0)**, provide **high accuracy**, and reproduce complex line drawings with precision. Unlike standard printers, plotters move a pen or a printing head over the surface, which allows them to create sharp lines and detailed curves. This makes them ideal for architectural blueprints, circuit diagrams, and mechanical part designs.

Answer:

Conclusion:

After comparing the available devices, the only option that meets all requirements is the **Plotter**. It is purpose-built for producing large, precise, and professional-quality technical drawings, making it the best choice for the engineering design firm.

Summary

In this lecture, we covered essential output devices.

On the output side, we explored display technologies like LED and LCD screens, along with printers and multimedia projectors, which bring digital data to life.

We highlighted how these devices are crucial for effective data interaction and presentation.