A-level
Computer Science

Output devices

Lesson Objectives

Students will learn about:

- Output devices and its working in detail.
- Applications of output devices

1.

Content

Output devices

- Output devices help transfer processed data to users.
- The output data can be images, videos, sound and machining code.

Inkjet printers

There are two types of scanner: 2D printers and 3D printers.

Inkjet printers

Part	Function
Print head	Consists of nozzles that spray drops of ink on to the paper to form different characters.
Ink cartridges	Each cartridge consists of a group for each colour (blue, yellow and magenta) and a black cartridge.
Stepper motor and belt	Moves the print head assembly across the page side to side
Paper feed	Automatically feeds the printer with pages as required.

Technologies to produce ink droplets

Thermal bubble:

Tiny resistors produce localised heat that vaporises the ink.

The bubble of ink is ejected from the paper head onto the paper.

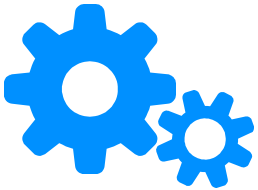
When the bubble of ink collapses, a vacuum is created to draw fresh ink from the print head.

Piezoelectric:

A crystal at the back of the ink reservoir is given an electric charge and vibration is created.

This vibration forces the ink to be ejected onto the paper.

Printing process



Data is sent to the printer driver. Printer driver checks the format and availability of the printer. Data->buffer

The sensor checks the paper feed tray. The printer head moves from side to side and the ink of four colours are sprayed in correct proportion to get the desired colour.

Once a line is completed, the paper moves slightly to print a new line. The previous process is repeated until the buffer is empty.

Once the buffer is empty, the printer sends an interrupt to the processor and requests more data. The whole process continues until the document is printed.

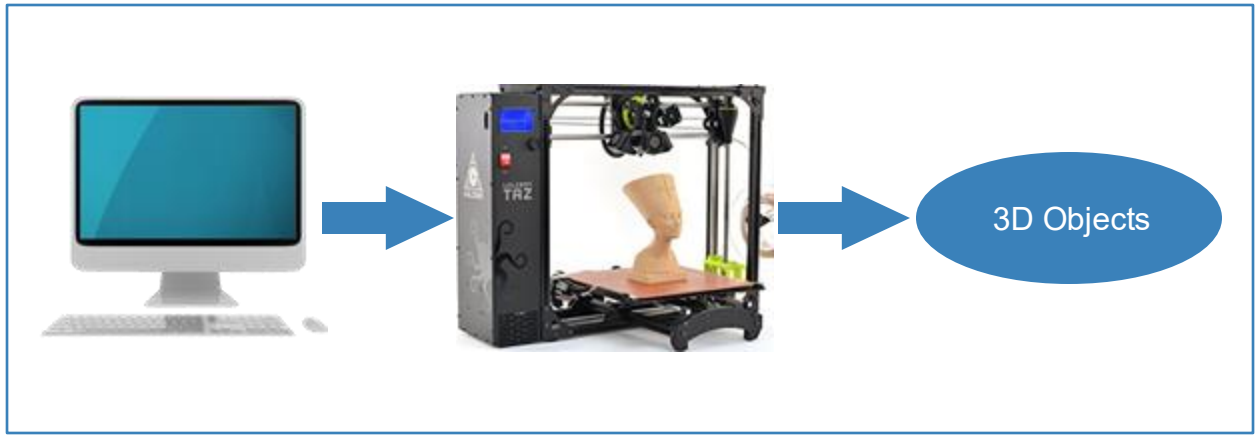
Laser printers

Laser printers

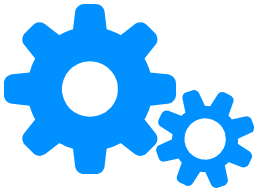
- A laser printer uses dry powder ink rather than liquid ink as in inkjet printers.
- Uses static electricity to print.
- Prints the whole page in one go.
- Carries large print jobs at a good speed and does not run out of ink halfway.

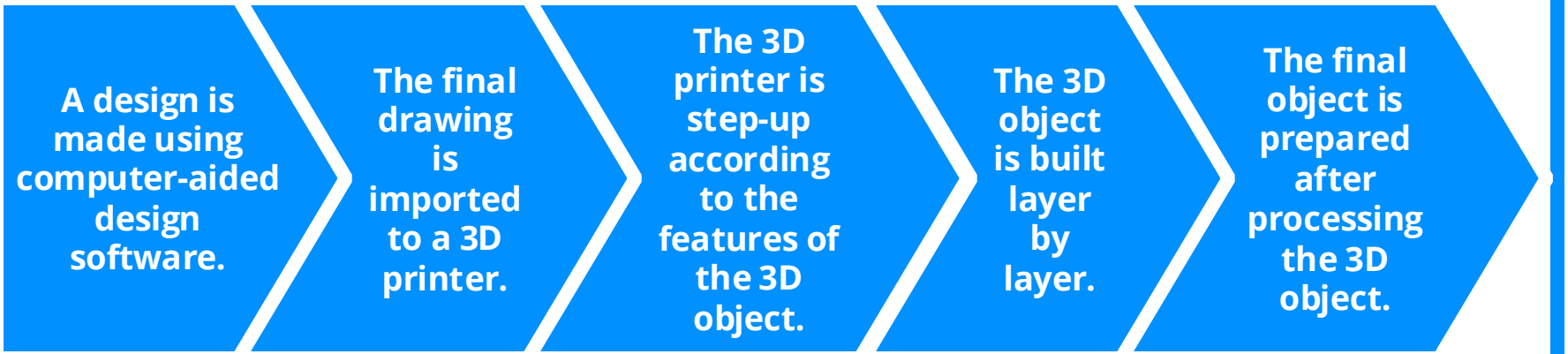
3D printers

- 3D printers are widely used in computer-aided design to produce solid objects of various materials, such as powdered resin, paper, ceramic powder, etc.



3D printer

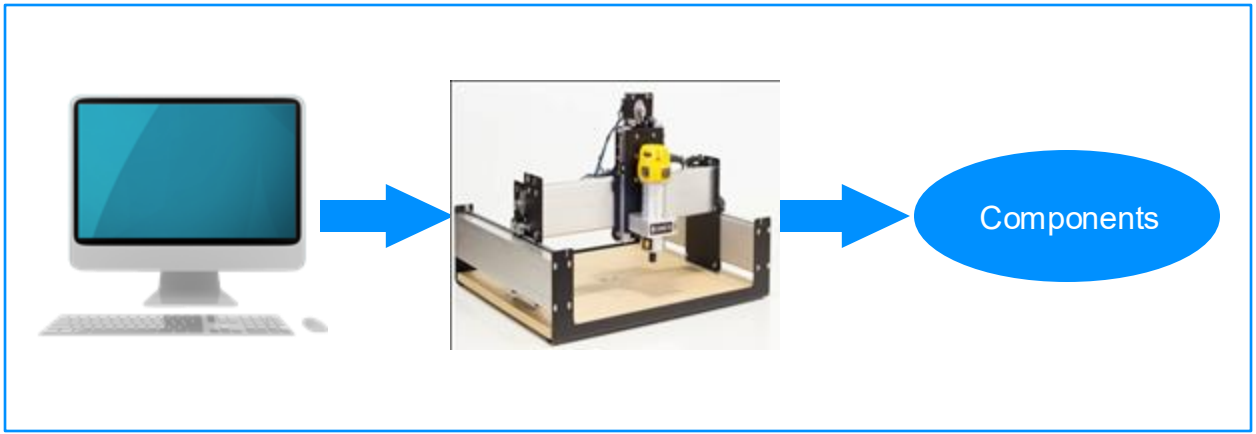




In 3D printers, the objects are built layer by layer. Each layer is only 0.1 mm thick.

2D and 3D cutters

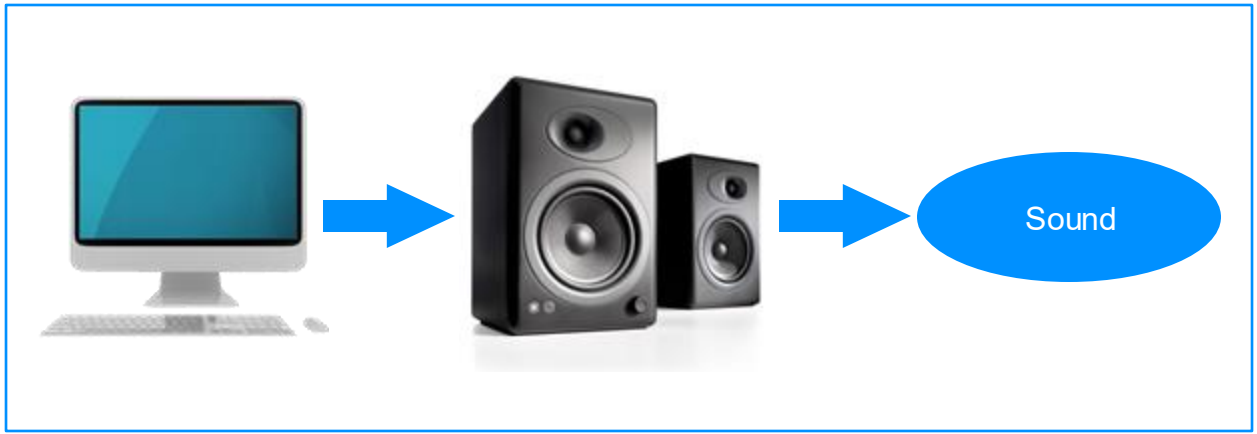
- Laser cutters can cut through materials such as glass, crystal, metal, polymers and wood.



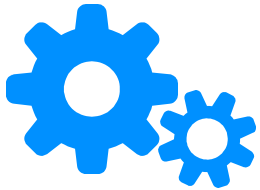
2D and 3D cutters

- Very complex and intricate designs can be cut through the materials using sophisticated software.
- The coordinates are used to recognise the object.

Loudspeakers/Headphones



Loudspeaker/Headphones



Digital data stored in the computer is converted to analogue data that can vibrate a cone in a speaker. (DAC)

The sound wave is passed through the amplifier

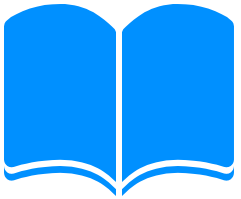
Sound emerges out of a loudspeaker

Digital to analogue converter

- The DAC converts digital data to analogue data at a rate called sampling rate.
- The sampling rate for a 16-bit DAC is 44100 samples per second. This means that the DAC can convert 44100 values in the range +32767 to -32768 every second.

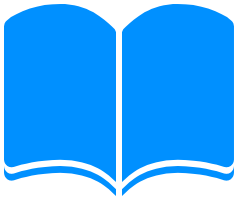
LCD and LED monitors

LCD and LED monitors



- Liquid Crystal Diode/Display (LCD) monitors have replaced Cathode-ray monitors.
- LCD monitors consist of tiny diodes grouped in threes or fours for a pixel. The three basic diode colours are red, green and blue.
- An extra yellow diode is included to make colours more vivid.
- Early LCD monitors used cold cathode fluorescent lamps (CCFL) for backlighting.
- Modern LCDs use groups of LEDs for backlighting.

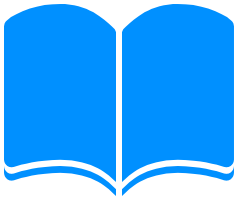
LCD and LED monitors



The advantages of LEDs over CCFL technology are:

- LEDs reach maximum brightness almost immediately.
- LED gives a whiter light that sharpens the image and makes the colour more vivid.
- Monitors using LEDs are thinner compared to CCFLs.
- LEDs have a long lifetime, lasting almost indefinitely.
- LEDs consume very little power.

LCD and LED monitors



- Futuristic LED technology uses organic compounds to create semiconductors that are flexible. This technology is called Organic Light Emitting Diodes (OLEDs). No backlighting is required in these types of LEDs as they can produce their own light. Hence, the screens are much thinner.
- LED and LCD screens are widely used in hand-held devices such as mobile phones, tablets, game consoles, etc. These screens are thin, light-weight and very responsive to touch.

Light Projectors

Projectors are used to project the output of computers onto a large screen or even an interactive whiteboard.

Types of light projectors

Digital light projector:

A digital light projector consists of millions of micro-mirrors.

When a micro-mirror is tilted towards the light source, it is ON. When it is tilted away, it is OFF. Millions of micro-mirrors combine to create dark and bright pixels on the screen.

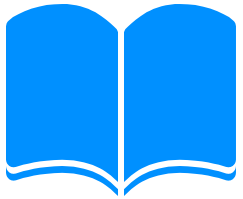
These mirrors can switch several thousand times a second to produce 1024 different grey shades.

LCD Projectors

LCD projects are older technologies compared to DLP.

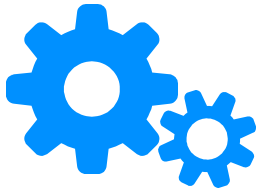
A high-intensity light beam passes through an LCD display and then falls on a screen.

Coloured images in DLP



- Coloured images are projected by using a passing white light through a colour filter on its way to a DLP chip.
- The white light is split into different primary colours and over 16 million different colours can be produced.
- The state of each micro-mirror is linked to the colour filter to determine the pixels of the coloured image.

Steps in LCD projectors



1. A powerful white light is generated using a bulb or LED from the projector.
2. Light falls on a set of chromatic-coated mirrors, which reflect the light at different wavelengths.
3. Each coloured component of light is passed through an LCD screen that projects the image in greyscale.
4. Images are then combined using a special prism to produce a full-colour image.
5. Images pass through the projector lens and then onto the screen.

2.

Activities

Activity-1 (Internet Research)

Duration: 15 minutes

1. How are various colours printed using laser printers?
2. Cakes are printed with images these days. Use the Internet to find out how these images are printed. Write about the ink that is used, the technology used for printing images, etc.

Activity-2 (Internet Research)

Duration: 20 minutes

1. Find out what type of display do the TVs, computers and laptops have in your home. You may use the model numbers to search the Internet.
2. Use the Internet to find information about OLED technology. What are the advantages of OLED technology when compared to LED and LCD technology?

3.

End of topic questions

End of topic questions

1. What are the different technologies used by inkjet printers to spray ink?
2. What are the different stages of the printing process in inkjet printers?
3. How is the working of laser printers different from an inkjet printer?
4. What are cutters used for in industries?
5. How does a digital light projector create black and white pixels on the screen?
6. How is a coloured image produced by a digital light projector?