Input and output devices

Input Devices

Keyboards

Alphanumeric Keyboard

A very common, **general purpose**, input device that allows **text** (abc…), **numbers** (123…) and **symbols** (%$@...) to be entered into a computer.

A keyboard is simply a set of buttons. Each button has a symbol assigned.

Numeric Keypad

A small keyboard that only has **numbers**.

Used to enter **numeric data** into computers such as those in ATMs.

Most computer keyboards have a numeric keypad on the right side, and most mobile phones (there are also computers) have a one for entering phone numbers, etc.

PIN Pad

This is a device with a **numeric keypad** used to enter a person's **Personal Identity Number** (PIN) e.g. when paying with a credit card.

PIN pads are also found on electronic door **locks** – you enter a PIN to unlock the door.

Pointing Devices

These devices are used to move an on-screen pointer or cursor (usually an arrow). They are commonly used with Graphical User Interfaces (GUI).

Mouse

A **pointing** device found on most PCs. Sensors on the bottom of the mouse detect when the mouse is moved. Data about this movement is sent to the computer.

Often used to control the pointer in a **GUI**.

Touchpad / Trackpad

A **pointing** device found on most **laptops**. Used instead of a mouse since it takes up **less space**. The user moves a finger across the touch pad and this movement data is sent to the computer.

Usually used to control the pointer in a **GUI**.

Trackball / Tracker Ball

This **pointing** device is not moved about like a mouse, instead it has a **large ball** that the user spins. Data about which direction the ball is spun is passed to the computer.

It can be used to control a **GUI** pointer.

Tracker balls are often used by people with **limited movement** (disabled) or by the **very young** since they are **easier to use** than a mouse.

Touch Screen

A touch screen is an alternative to a separate pointing device. With a touch screen the user selects items on the screen by **touching** the surface. This makes touch screen systems very **intuitive** and **simple to use**.

Often used for **information terminals** in public places e.g. libraries or museums where mice or keyboards may be stolen or damaged.

Graphics Tablet

A **pointing** device often used by **designers** and **artists** to allow **natural hand movements** to be input to **graphics** applications.

A stylus is held like a pen and moved over the surface of the tablet. Data about the stylus movements are sent to the computer.

Since it is so like using a pen, it is very easy to create '**hand-drawn**' sketches.

Joystick / Joypad

Used mainly for playing **games**. The user moves the joystick left/right, forward/back and data about these movements are sent to the computer.

Small joysticks can also be found on some **mobile phones**.

Light Pen

A light pen is a device used as a **pointing** device or to '**write**' on the **screen** of a computer.

Light pens are **rarely used** today since graphics tablets and high-quality touch screens provide similar functionality.

Audio/Visual Devices

Scanner

A device that 'scans' **images**, book pages, etc.

Scanning is basically taking a close-up photograph (just very slowly and with great detail). The scanned image data is passed to the computer.

The most common type of scanner is the **flat-bed** scanner which has a glass plate on which the item to be scanned is placed. The item is illuminated and an image of it is captured by a moving scan 'head'.

Scanned images can be further processed once inside the computer, e.g. **OCR** of printed text.

Digital Camera

A device that captures **digital photographs**.

Most digital cameras do not directly input data into a computer - they store photographs on **memory cards**. The photographs can later be **transferred** to a computer.

A modern digital camera can capture 10 Megapixels or more per photograph - that's 10,000,000 coloured dots (pixels) in every photo!

Video Camera

A device that captures **moving images**, or **video**.

Like a digital camera, most video cameras do not directly input data into a computer – the captured movies are stored on **video-tape** or **memory cards** and later **transferred** to a computer.

However, there are some situations where video cameras do feed video data directly into a computer: **television production** and **video-conferencing**. In these situations the video data is required in real-time.

Web Cam

This is a very **basic video camera** used to feed **live video** into a computer.

The video data from a web cam is **low quality** compared to a full video camera. However it is good enough for **web chats** (e.g. using a messenger application such as MSN Messenger or Skype).

Usually a web cam is clipped to the top of a monitor, but many laptops now have web cams built into the edge of the screen.

Microphone

An input device that converts **sound** into a signal that can be fed into a computer.

The signal from a microphone is usually **analogue** so, before it can be processed by a computer, it must be converted into digital data. An **Analogue-to-Digital Convertor (ADC)** is used for this (usually built into the computer's sound card)

Many headphones now come with microphones to allow them to be used with chat and phone applications.

Card Readers

Magnetic Strip Reader

Many plastic cards, such as credit cards, have a **strip of material that can be magnetized** on the back. Data can be stored here in the form of **magnetized dots**.

Usually the **data stored on this strip** in the same **data shown on the front** of the card (e.g. the credit card number, expiry date and customer name).

The stripe allows this data to be input to a computer system **faster** and **more accurately** than by typing it in.

A magnetic strip/stripe reader is used to read the data from the stripe. This is usually done by '**swiping**' the card through a slot on the reader.

Smart Card / 'Chip' Reader

Modern credit cards and ID cards don't use a magnetic strip. Instead they have a tiny '**chip**' of computer **memory** embedded inside them. (These cards are often referred to as **smart cards**.)

Data can be **stored** in this memory and **read back** using a 'chip' reader.

A card is inserted into the reader where metal contacts connect to the **metal pads** on the front face of the card. The reader can then **access the memory chip** and the **data** stored on it.

Smart cards can **store much more data** than magnetic strip cards, e.g. an ID smart card would store not only the owner's name and card number, but might also have a digital image of the person.

Satellite TV decoders use smart cards to store which channels a user has paid for. The data is **encrypted** so that it is not easy to alter (you can't add new channels without paying!)

Many types of card use this system: **id** cards, **phone** cards, **credit** cards, **door security** cards, etc.

Reading Text/Codes

All data can be input to a computer using a keyboard, but this would often be a slow process, and mistakes would be made. Sometimes speed and accuracy is required.

MICR Reader

Magnetic Ink Character Recognition (**MICR**) is a technology that allows details from **bank cheques** to be read into a computer **quickly** and **accurately**.

The **cheque number** and **bank account** number are printed at the bottom of each bank cheque in **special magnetic ink** using a **special font**. These numbers can be detected by an **MICR reader**.

OMR Scanner

Optical Mark Recognition (**OMR**) is a technology that allows the data from a **multiple-choice** type form to be read **quickly** and **accurately** into a computer.

Special OMR forms are used which have spaces that can be **coloured in** (usually using a pencil). These **marks** can then be **detected** by an **OMR scanner**.

Common uses of OMR are **multiple-choice exam** answer sheets and **lottery number** forms.

OCR Scanner

Optical Character Recognition (**OCR**) is a software technology that can **convert images of text into an actual text file** that can then be edited, e.g. using word-processing software). The result is just as if the text had been typed in by hand.

OCR is typically used after a page of a book has been **scanned**. The scanned **image** of the page is then **analyzed** by the **OCR software** which looks for recognizable **letter shapes** and generates a matching text file.

Advanced OCR software can recognize normal **handwriting** as well as printed text - this is usually called **handwriting recognition**.

Barcode Reader / Scanner

A barcode is simply a **numeric code** represented as a series of **lines**.

These lines can be read by a **barcode reader/scanner**.

The most common use of barcode readers is at **Point-of-Sale** (**POS**) in a shop. The **code** for each item to be purchased needs to be entered into the computer. Reading the **barcode** is far **quicker** and more **accurate** than **typing** in each code using a keypad.

Barcode can be found on many other items that have numeric codes which have to be read quickly and accurately - for example ID cards.

Sensors

A normal PC has no way of knowing what is happening in the real world around it. It doesn't know if it is light or dark, hot or cold, quiet or noisy. How do we know what is happening around us? We use our eyes, our ears, our mouth, our nose and our skin - our **senses**. A normal PC has no senses, but we can give it some: We can connect **sensors** to it...

A **sensor** is a device that **converts** a **real-world property** (e.g. temperature) into **data** that a computer can **process**.

Examples of sensors and the properties they detect are...

Sensor	What it Detects
Temperature	Temperature
Light	Light / dark
Pressure	Pressure (e.g. someone standing on it)
Moisture	Dampness / dryness
Water-level	How full / empty a container is
Movement	Movement nearby

Proximity	How close / far something is
Switch or **button**	If something is touching / pressing it

A sensor measures a specific property data and sends a signal to the computer. Usually this is an **analogue** signal so it needs to be converted into **digital** data for the computer to process. This is done using by an **Analogue-to-Digital Converter** (ADC).

Sensors are used extensively in **monitoring / measuring / data logging systems**, and also in **computer control systems**.

Remote Control

These devices are very common. They send data signals each time a button is pressed using infrared or radio signals.

The signals can control a computer from some distance. They are often used to control a presentation slideshow.

Output Devices

Audio/Visual Devices

CRT Monitor

A monitor displays text and image data passed to it by the computer.

A cathode-ray tube (CRT) monitor is the type that has been around for years and is large and boxy.

CRT monitors are heavy and they take up a lot of desk space. They have largely been replaced by flat-screen monitors. However some are still used in the design industry since the colour accuracy and brightness of CRT monitors is excellent, and designers need to see true-to-life colours.

Also, CRT monitors are generally cheaper than flat-screen monitors.

Flat-Screen Monitor (TFT or LCD)

Over the past few years, as they have come down in price, flat-screen displays have replaced CRT monitors.

Flat-screen monitors are light in weight and they take up very little desk space.

Modern flat-screen monitors have a picture quality that is as good as CRT monitors.

Digital / Multimedia Projector

Digital projectors are used in situations when a **very large viewing area** is required, for example during **presentations**, for **advertising**, or in your home for **watching movies**.

A projector connects to a computer, a DVD player or a satellite receiver just like an ordinary monitor. The image is produced inside the device and then projected out through a large lens, using a powerful light source.

Speakers

If you want to hear **music** or **sounds** from your computer, you will have to attach speakers. They convert electrical signals into **sound waves**.

Speakers are essential for applications such as **music editing**, **video conferencing**, watching **movies**, etc.

Printing/Plotting Devices

Dot Matrix Printer

A dot-matrix printer is named after the pattern (a grid or 'matrix') of dots used when creating the paper printout.

These dots are formed by tiny pins in the printer's print head that hit an inked ribbon against the paper leaving marks. As the print head moves along it leaves a pattern of dots behind it which can form letters, images, etc.

Dot matrix printers often use continuous stationary: long, continuous strips of paper (rather than separate sheets of A4 like ink-jet and laser printers use).

After printing, the printout is torn off from the long strip.

Dot-matrix print quality is poor, the printers are noisy, and there are much better printing systems available today. However, the dot-matrix printers are still used in certain situations:

Since the pins actually hit the paper, several 'carbon-copies' can be printed in one go. An example of this is airline tickets which have several duplicate pages, all printed in one go.

The print mechanism is very cheap, and the inked ribbons last for a long time. So, where cheap, low-quality printouts are required, dot-matrix printers are used. An example is shop receipts.

InkJet Printer

Cheap, high-quality, full-colour printing became available during the 1980s due to the development of ink-jet printers.

These printers have a similar print-head mechanism to a dot-matrix printer. The print-head passes left and right across the paper. However, instead of using pins to hit inky marks onto the paper, the ink-jet squirts tiny droplets of ink onto the surface of the paper. Several coloured inks can be used to produce full-colour printouts.

The droplets of ink come from tiny holes (the jets) which are less than the width of a human hair in size. Each droplet creates a tiny dot on the paper. Since the dots are so small, the quality of the printout is excellent (1200 dots-per-inch are possible). This is perfect for photographs.

Ink-jet printers are very quiet in use. Since they have so few moving parts they are also cheap to manufacture and thus cheap to purchase. However, the ink is very expensive to buy (this is how the printer companies make their profits!) so the printers are expensive to use.

Laser Printer

Laser printers are very complex devices, and thus expensive to buy. However they are very cheap to use. This is because they produce marks on paper using a fine dust called toner which is relatively cheap to buy. A single toner cartridge will often last for 5,000-10,000 pages of printing.

The laser printer uses a complex system, involving a laser, to make the toner stick to the required parts of the paper. (This system is very different to a dot-matrix or ink-jet, and you don't need to know the details.)

The laser and toner system allows very fast printing compared to other printers (just a few seconds per page).

Laser printers are very common in offices since they print very quickly, are cheap to use and are reasonably quiet.

Plotter

Plotters create hard-copy in a very different way to printers. Instead of building up text and images from tiny dots, plotters draw on the paper using a pen.

The pens are held in an arm which can lift the pen up or down, and which can move across the paper. The arm and pen create a drawing just like a human could, but much more accurately and more quickly.

Different coloured pens can be used to produce coloured line drawings.

Plotters are often used by designers and architects since they work with huge pieces of paper, far bigger than anything a normal printer could work with.

Control Actuators

A normal PC has no way of affecting what is happening around it. It can't turn on the lights, or make the room hotter. How do we change what is happening around us? We use our muscles to move things, press things, lift things, etc. (and we can also make sound using our voice).

A normal PC has no muscles, but we can give it some. In fact we can give it the ability to do lots of things by connecting a range of actuators to it.

An actuator is a device, controlled by a computer, that can affect the real-world.

Examples of actuators, and what they can do are...

Actuator	What it Can Do
Light bulb or LED	Creates light
Heater	Increases temperature
Cooling Unit	Decreases temperature
Motor	Spins things around
Pump	Pushes water / air through pipes
Buzzer / Bell / Siren	Creates noise

Actuators are used extensively in computer control systems.

Motor

Motors can provide movement.

For example, the motor in a washing machine can be controlled by a computer - it is switched on when the clothes are loaded for washing and switched off at the end of the wash.

Computer-controlled motors are also found in microwave ovens (to turn the food around) and air-conditioning units (to drive the fan)

Pumps

A pump is basically a motor attached to a device that can push water or air along pipes. When the motor is switched on, water or air flows along the pipes to places it is needed.

Pumps are used in many places: as part of watering systems in greenhouses, in factories, etc.

Buzzer

Buzzers can provide noise.

For example, the buzzer in a microwave oven can be switched on by the controlling computer when the food is cooked.

Louder noises can be made using a siren or an electric bell, for example in a burglar alarm system.

Lights

Light bulbs and LEDs can be used to provide light, or to indicate something.

For example, computer-controlled lights are used in traffic lights, at music concerts. Lights are used in car dashboards to show if any of the systems in the car have problems.

Heaters / Coolers

Heaters can provide heat, and coolers can cool things down.

A computer can switch a heater on or off when needed to keep a room or a greenhouse at the correct temperature during winter.

A computer can switch a cooling unit on or off to keep a room at the correct temperature during hot weather, or to keep food fresh.