Input and output devices

We have seen that in order to process data, it has to be in binary form. However, people who use the computers do not use binary to code the data. It is therefore necessary to have devices in the computer that convert data in and out of binary form.

An input device is a device that allows the user to input data into the computer. This will normally involve taking the data in a form that the user presents and converting it into binary code for the computer.

An output device is a device that takes the result of the processing from the computer and presents it as information to the user. The result from the processing is raw binary data, but by converting it into a form that is meaningful to the user, such as a picture or a sound, the output device turns it into useful information.

In this section we look at different types of input and output devices.

Standard input devices

The keyboard

Keyboards are one of the most common input devices and are inspired from earlier mechanical typewriters. They are still very much in use because they are an efficient way of inputting text characters. When you type a key on the keyboard, the circuit on the keyboard sends a signal to the computer which corresponds to the key that has been pressed.

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The mouse and other pointing devices

A mouse is used as a pointing device for computers with a graphical user interface. It has sensors that detect whether the mouse has been moved, and, if so, in which direction. This information is then transfered to the computer which can move a pointer on the screen accordingly.

Most mice also have additional buttons which when pressed (or clicked) tell the computer to do something with the item that the pointer is currently pointing at. Some mice also have scroll wheels, which are used to move the screen image.

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There are a number of other pointing devices that can be used just like a mouse. Many portable computers have a touchpad. If the user moves a finger across the pad, this moves the pointer on the screen. Some portable computers have a small stick, like a joystick, instead of a touchpad, that can be pushed in any direction to move the pointer in that direction.

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Another type of pointing device is the tracker ball which is made of a ball which sits in a cup with a sensor under it. The user can move the ball within the cup to move the pointer.

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Microphone

Computers are increasingly making use of sound as in input and the main way of doing this is using a microphone. The microphone converts the sound into an electrical signal which can then be represented in binary code for the computer to process. In Section 4, you will study how it is converted.

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Camera

A digital camera has a lens which focuses the light received by the camera to make an image on a small plate covered with millions of tiny components that are sensitive to light. Each component then records the light that falls on it as a pixel (which stands for Picture Element). The pixels are put together to make the photograph.

A webcam is a digital camera that is connected to a computer allowing the picture taken to be immediately transmitted across the internet, for example. This is useful in applications like video conferencing where people can have a 'face-to-face' meeting even though they are miles away from each other.

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Scanner

A scanner is an input device that is usually used to input an image of a page of document. A strip of light is shone across the page, and a strip of light sensors record the light that is reflected off the page. Although this only produces an image of the page, this image can be processed further using optical character recognition (OCR) software which recognises the shapes of the letters on the page and converts the image into text.

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Standard output devices

Monitor

The monitor is probably the most common output device used by computers. Many modern monitors are flat-screen LCD or OLED displays. These displays are made up of thousands of tiny pixels which each light up individually to compose the picture. If you look very closely at a monitor, you will be able to notice these individual pixels.

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Printer

Most people who use a computer to produce documents will, at some point, want a print out of the document. This is called a hard copy and it can be produced on a printer. Two common types of printer are the ink-jet printer and the laser printer.

An ink-jet printer works by squirting tiny droplets of ink onto the page from an ink cartridge. Colour printouts are obtained by using multiple cartridges containing colours such as black, yellow, cyan (a mixture of blue and green) and magenta (a mixture of blue and red). These colours can be mixed to obtain any colour desired.

A laser printer works by aiming a laser beam in the shape of what needs to be printed onto a special drum. The drum contains tiny components that generate tiny charges of static electricity if touched by the laser. The drum is then put in the toner. This is a fine black or coloured powder, not liquid ink. The components on the drum attract or repel particles of toner depending on how they are charged with static electricity. The image this creates is then transfered onto a sheet of paper. It is then fixed by heating and pressing the toner to make it fuse into the sheet of paper. Colour printouts are obtained by repeating this process for black, yellow, cyan and magenta.

Some printers can be very specialised, such as printers that print only photographs of the right size for displaying in family photo albums etc.

A plotter is a special kind of printer often used for producing complex technical line drawings which need to be very precise, such as architects' drawings or engineering designs. The plotter is like a robotic arm and a series of pens. The arm picks up the pen required and draws the image onto a large sheet of paper.

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Speakers

Speakers are used to output sound from the computer. Often a sound card is used alongside the processor to produce this sound. The sound card is a special processor that receives the digital data and can convert this to an anologue electrical signal which is then sent to the speaker and converted to sound.

Input/output devices

An input/output (I/O) device is a device that can be used both for input and for output. Sometimes, this consists of a separate input and output device in the same box, for example a keyboard with a build in LCD display.

A typical I/O is the touchscreen monitor. Touchscreen monitors have become especially popular with devices such as tablet computers and mobile phones. They make the user interface seem more natural because you touch directly the objects you want to interact with. Multitouch touchscreen monitors make the interaction even more natural because the screen can recognise when it is touched more than once at the same time. This allows complex gestures to be used to contol the computer, such pinch to zoom and unzoom.

Users with specific needs

Users are very different to one another and there are often times when a particular type of common input or output device is not adequate for a particular user. This applies especially when the user is disabled. The following paragraphs describe some types of input and output devices that have been designed to allow disabled users to use computer systems.

Braille devices

Braille is a system wthat allows blind people to read and write using an alphabet of raised dots on a sheet of paper. Blind users can use a braille keyboard which allows the user to input text directly as braille.

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Some of these keyboards also have a row of plastic braille dots that can be lowered and raised by the computer to send text back to the user (so that, for example, the user can check what has just been typed). Such an output is called a refreshable braille display.

Many blind users are also able to use a standard keyboard. To assist them further, the letters on the keys may be printed in Braille rather than written on the keys as on a standard keyboard. Some people are partially sighted, so sometimes a keyboard with extra large keys or extra large text on the keys is all that is needed to make the keyboard usable.

To obtain a hard copy, Braille users can use a special 'printer' that, instead of putting ink on the paper, punches the braille dots from behind the paper to form the raised letters.

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Devices for users with limited mobility

Specialised input devices have been created for users who cannot use a standard keyboard because they have limited use of their arms and hands.

Eye-tracking devices include a camera facing the user while the user is looking at a computer screen. The camera records the movements of the user's eyes, and uses this to find work out where the user is looking on the

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screen and move the pointer there. This therefore replaces a pointing device like a mouse. Other replacements for pointing devices include head movement devices and mouth sticks (a joystick controlled by the mouth). Such devices can be used in conjunction with a number of switches, allowing the user to click on the item selected. The user can also enter text by using an onscreen keyboard.

Some devices are desinged only to make inputting of text easier. There have been many designs for keyboards which could be used with one hand. This is useful for users who can only use one of their hands.

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Another specialised keyboard is the concept keyboard that, rather than have general keys which can be used to input letters to make any text, has got keys which represent entire concepts or sentences, so that the user only needs to press one key to generate a whole sentence or command.

Note that computers may also use software along with standard devices to help enable users to interact with the computer. For example, speech synthesis can be used to convert pieces of text to speech for visually disabled users. Speech recognition allows the user to speak into a microphone to send commands to the computer or write documents.