

## Input devices

An input device is hardware that allows a computer to receive data from the outside world.

### 2D scanners

These convert hard-copy documents into an electronic form which can be stored in a computer memory. Scanners operate by using a scan head which moves across the document producing an image which is sent to a lens via a series of mirrors. The focused image falls onto a charge-coupled device (CCD) which consists of a number of integrated circuits (made up of thousands of light-sensitive elements that turn light into an electric charge). Consequently, the original document is turned into a format which can be stored in a computer's memory. One application of 2D scanners is at an airport where they can read passport pages and allow, for example, a photographic image of a person's face to be compared to an image just taken by a digital camera. This involves the use of face-recognition technology to identify passengers.

### 3D scanners

3D scanners scan solid objects and produce an electronic 3D image. They make use of, for example, lasers, magnetic resonance, white light or X-rays.

CT (computed tomography) scanners are used to produce a 3D image of a solid object. Tomography technology splits up the object into a number of very thin 'slices'. They tend to use X-rays, radio waves or gamma imaging methods. The resultant image allows a solid object to be stored as a series of digital values representing each 'slice'.

- X-rays: CT (computed tomography) scanners.
- Radio waves: MRI (magnetic resonance imaging) scanners.
- Gamma rays: SPECT (single-photon emission computed tomography) scanners.



## Barcode readers

Barcodes consist of a series of dark and light lines of varying thickness.

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Each digit or character is represented by a number of lines. Whilst barcodes which use digits only are the most common in supermarkets, many can also display other characters.

Each dark and light line can be represented by the binary values of 1 (dark line) or 0 (light line); e.g. L D L D D D D, which represents the light and dark lines for the digit '6' in one system, can be represented as 0 1 0 1 1 1 1 in the computer.

Barcodes are used in supermarkets to find prices of goods and to enable automatic stock control. They are also used extensively in library systems to track the whereabouts of books. The advantages to managers include:

- easier and faster to alter prices
- give instantaneous and comprehensive sales trends
- no need to price each item (saves time and money)
- allows automatic stock control
- can check customer's buying habits more easily.

Advantages to customers include:

- faster checkouts
- less chance of errors
- get an itemised bill
- cost savings can be passed on to customer
- better tracking of 'sell by dates'.



## QR (quick response) codes

QR codes are a type of barcode. However, they can hold considerably more data.

QR codes are usually read by built-in cameras in smart phones or tablets using an installed app. Once the QR code has been scanned, it will send information back to the phone or tablet, e.g. a website link or general information (e.g. a phone number or 'special offer').



## Digital cameras

Digital cameras contain a microprocessor which automatically:

- adjusts shutter speed
- focuses
- operates the flash
- adjusts the aperture
- removes 'red eye'
- reduces hand shake, and so on.

Images are captured when light passes through the lens onto a light-sensitive cell, which is made up of thousands of tiny elements called pixels. The number of pixels determines the size of the file needed to store the image.





## Keyboards/keypads

Keyboards are the most common input device; keys are pressed by the operator to enter data directly into the computer. When a key is pressed, it completes a circuit and a signal is sent to the microprocessor which interprets which key has been pressed. Since entering data by keyboard is a relatively slow process, most computer systems use a keyboard buffer which prevents the microprocessor waiting for keys to be pressed. Although little training is needed to use a keyboard, they do pose a health risk to operators who do a lot of continuous typing – the health risk is known as RSI (repetitive strain injury).

## Pointing devices

The most common pointing devices are the mouse and the trackerball. They are used to control a cursor on screen or to select options from menus. The mouse usually has two buttons (used for selection and other functions) together with a scroll up/down wheel.

Trackerballs use a ball on the top or side of the device which enables control of a cursor or selecting options from a menu. They are often the preferred device in control rooms since they don't require as much desk space as a mouse and are also less likely to cause such problems as RSI (caused by repeated clicking of a mouse button).



## Microphones

Microphones are used to input sound into a computer. When the microphone picks up sound, a diaphragm vibrates producing an electric signal. A sound card in the computer converts the signal into digital values which can be stored in its memory.

Voice recognition uses microphones. It is used to identify if a 'known' person is speaking in, for example, a security system. The software compares wave patterns from the person's voice with wave patterns stored in memory. If the wave patterns match, then the correct person is identified.

Speech recognition also uses microphones but is very different to voice recognition. This works by first converting speech patterns into a digital form. The digital image is broken up into phonemes which are then compared with words stored in the built-in dictionary. The spoken words can then be recognised.

## Touchscreens

Touchscreens allow selections to be made by simply touching an icon or menu option on a screen. They are also used in many devices to allow input via a 'virtual keyboard'.

Mobile phones and tablets are some of the biggest users of touchscreen technology. The most common systems are capacitive, infra-red or resistive.

	Capacitive	Infra-red	Resistive
<b>Technology</b>	<ul style="list-style-type: none"> <li>uses layers of glass that acts a capacitor</li> <li>when the top layer is touched, the electric current changes</li> <li>microprocessor works out the coordinates of where the screen was touched</li> </ul>	<ul style="list-style-type: none"> <li>uses glass and can either detect heat or uses infra-red sensors to detect touch</li> <li>microprocessor works out where the screen was touched based on sensor/heat data</li> </ul>	<ul style="list-style-type: none"> <li>uses upper layer of polyester and bottom layer of glass</li> <li>when top layer touched, it completes a circuit</li> <li>microprocessor works out coordinates of where the screen was touched</li> </ul>
<b>Benefits</b>	<ul style="list-style-type: none"> <li>this is a medium-cost technology</li> <li>good visibility in strong sunlight</li> <li>allows multi-touch capability</li> <li>very durable</li> </ul>	<ul style="list-style-type: none"> <li>allows multi-touch capability</li> <li>can use bare fingers, gloved hand or stylus</li> <li>good screen durability</li> </ul>	<ul style="list-style-type: none"> <li>relatively inexpensive technology</li> <li>can use bare fingers, gloved hand or stylus</li> </ul>
<b>Drawbacks</b>	<ul style="list-style-type: none"> <li>can only use bare fingers or a conductive stylus</li> </ul>	<ul style="list-style-type: none"> <li>relatively expensive technology</li> <li>heat-sensitive systems only allow bare fingers to be used</li> </ul>	<ul style="list-style-type: none"> <li>poor visibility in strong sunlight</li> <li>doesn't allow multi-touch capability</li> <li>screen is vulnerable to scratches</li> </ul>





## Sensors

Sensors send data from the real world to a computer. They often require an analogue to digital converter (ADC) to change the data into a format that the computer (or microprocessor) can understand.

Sensors form part of many monitoring or control systems. Monitoring simply reports the status of a system via a computer/microprocessor. Control involves altering devices (e.g. open/close valve, switch on/off a heater or turn a pump on/off) so that effectively the output affects the next input to the computer. Many sensors exist depending on the application being monitored or controlled, for example, temperature, moisture/humidity, light, infra-red/motion, pressure, acoustic/sound, gas, pH or magnetic field.

Monitoring systems include: monitoring a patient's vital signs in a hospital, burglar/intruder alarm systems, checking key data in a car engine or monitoring pollution levels in a river or the air.

Control systems include: traffic light control, greenhouse environment, street lighting, anti-lock braking system on a vehicle or control of a chemical or nuclear process.

## Interactive whiteboards

Interactive whiteboards allow computer images to be displayed using a digital projector. They allow users to write on the whiteboard and the text/images created can then be stored in a computer memory.

Any image projected onto the screen can be annotated or even changed and the annotated version can then be saved for later use.

