# 7 Other output devices

Plotters

The most common type of plotter is the **flat-bed plotter**. A mechanical arm moves across a sheet of paper and a pen holder slides up and down the arm.

Plotters are often used in science and engineering applications for drawing building plans, printed circuit boards, machines and machine parts. They are accurate to hundredths of a millimetre and can be the size of a small classroom!

Mechanical arm

Pen
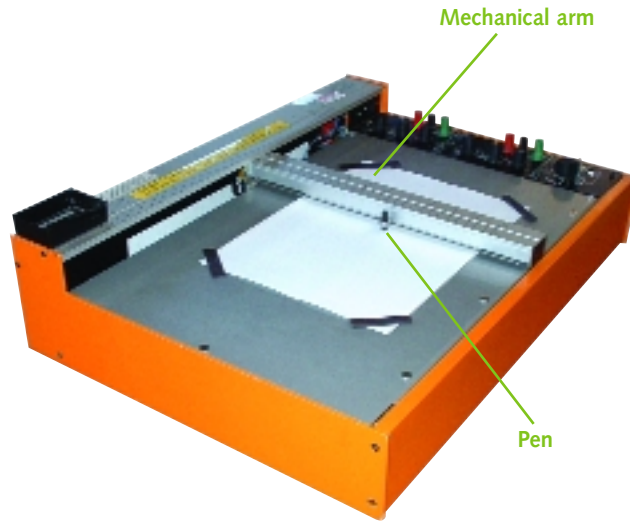
Sound/voice

Computers can output both music and speech to speakers. Synthesised speech output, generated from a computer program, can be particularly useful for blind users, where passages of text or figures from a spreadsheet (see *Section 16*) are spoken.

One common example of speech synthesis is used by telephone companies for their directory enquiry services. When you call them, the operator searches a computer database and locates the number you need. A computer then reads this number out to you by saying, "The number you require is …".
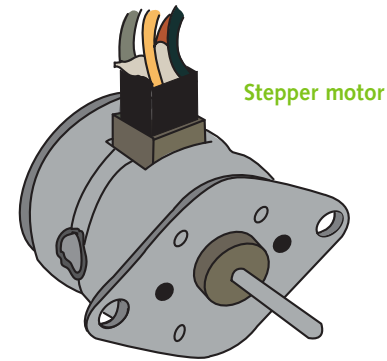
Speakers come in different shapes and sizes

Control applications

Computers are also able to output data to devices that control machines and processes.

Actuators

Mechanical devices that generate movement are called **actuators**. Computer-controlled actuators can automate the operation of machines and are based on three types of mechanism:

Stepper motor

Switches

Computers can output signals to switch equipment and machines on and off.

- **Motors** – A **stepper motor** is controlled directly by the computer – each electrical pulse from the computer rotates the motor shaft by a tiny amount. Stepper motors give very precise movements and are used in devices such as printers, plotters and robotic arms.
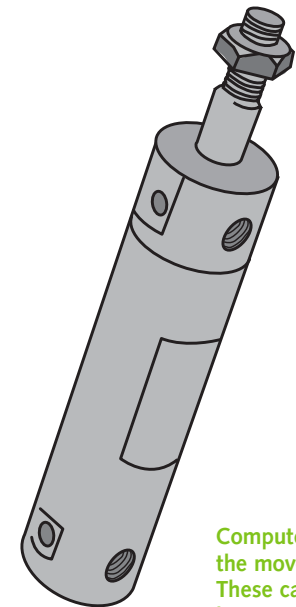
- **Hydraulics** – The computer output controls the movement of hydraulic rams by pumping oil. These hydraulic rams, like those on mechanical diggers and bulldozers, can be slow but are very powerful.

- **Pneumatics** – These are quite similar to hydraulics in using rams but the pistons are powered by air rather than oil. Pneumatics are not as powerful as the hydraulic systems, but they move much faster.

Computers can control the movement of rams. These can be operated by air (pneumatics) or oil (hydraulics)

When you dial directory enquiries, why is the number read to you by a speech chip and not by the operator?

11 Software

Software is the name given to the programs that run on computers. Hundreds of thousands of programs have been written to:

- help businesses run
- control robots in building cars
- generate weather forecasts
- provide home entertainment
- provide educational packages
- be destructive, eg computer viruses.

Synchronisation

Synchronisation is a term used for updating the data between two computers. For example, a salesman may use a calendar program on his notebook computer to enter appointments, while other appointments are being arranged for him at the office. When he connects his notebook computer to the office computer, the new appointments will be updated on both systems. If two appointments have been made on the same day, at the same time, then the conflict will be highlighted. Synchronisation is common in calendar, tasks and contacts programs (see opposite) and can also be used for databases and other files.
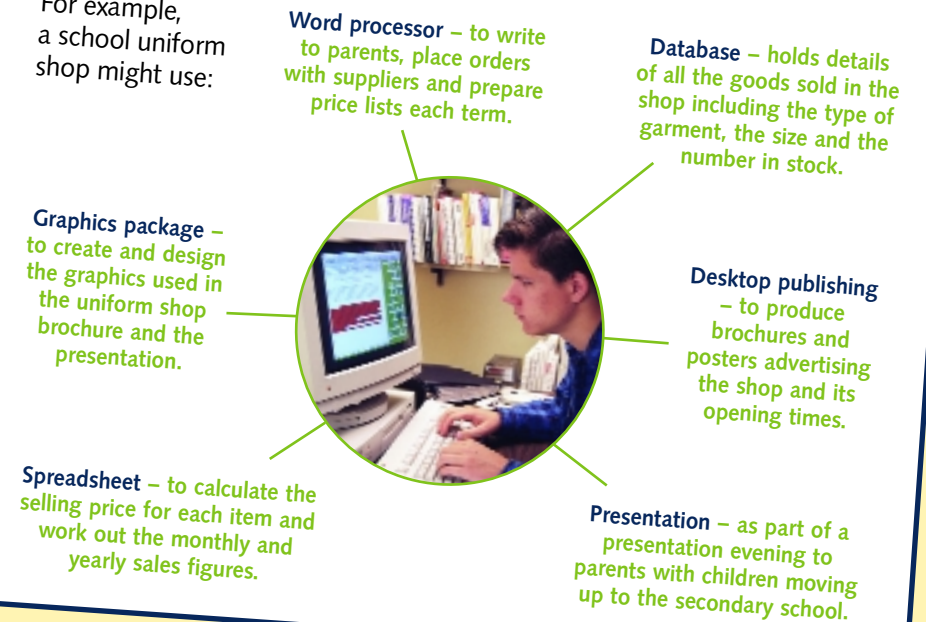
Writing software

Software is written by computer programmers using special computer language programs and tools. Some of these languages that were developed at the start of the computing era in the 1950s and 60s are still in use today, but the most popular languages for modern software development are those designed more recently to run on the latest operating systems and use the Internet. Just a few of the names of computer languages are Cobol, Fortran, Prolog, Lisp, Basic, Visual Basic, C, C++, XML, Access, SQL and Java.

In business

Spreadsheet – to calculate sales figures, prices for customers, discounts and profits.

Contacts – for maintaining up-to-date details on customers.

Word processor – to prepare sales reports and write letters.

Tasks – a task list so that important jobs are not missed.

Email – to keep in contact with colleagues and customers.

Database – available for reference with details of all the products they sell.

Calendar – for keeping a diary of appointments and meetings.

Web browser – to access the company Web site to show customers the latest product information.

In school

For example, a school uniform shop might use:

Word processor – to write to parents, place orders with suppliers and prepare price lists each term.

Database – holds details of all the goods sold in the shop including the type of garment, the size and the number in stock.

Graphics package – to create and design the graphics used in the uniform shop brochure and the presentation.

Desktop publishing – to produce brochures and posters advertising the shop and its opening times.

Spreadsheet – to calculate the selling price for each item and work out the monthly and yearly sales figures.

Presentation – as part of a presentation evening to parents with children moving up to the secondary school.

?

From the list of software above, decide which would be the best to: a) write a letter b) keep records of customers c) send a file to another office.
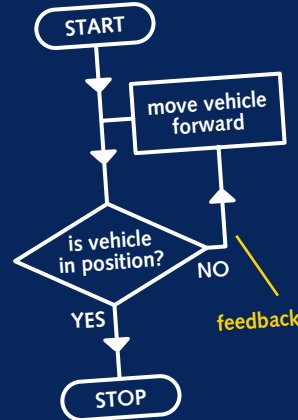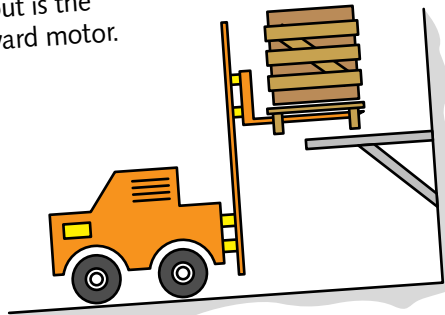
24 Computer control

Computers are used to control the operation of many machines and everyday objects. The computer program's instructions send signals from the computer to devices like switches and motors which make the machine operate correctly.

Feedback

In computer control, **feedback** means that input signals produce output changes that are monitored again by the input sensors. There is a loop from the sensor, through the processor to the output and back to the sensor.

An example of feedback is shown opposite. Here, a computer-controlled vehicle is moving into position to stack goods on a shelf in a warehouse. The input sensor switch is mounted at the front of the truck and the output is the forward motor.

START

move vehicle forward

is vehicle in position?

NO

YES

feedback

STOP

Embedded computers

When a computer is used to control a machine, a computer circuit board is installed inside the machine. Input sensors and output control devices are then connected to these circuits; this is an embedded computer. The input/output devices that you are most familiar with – the keyboard, mouse and monitor (see *Sections 3* and *6*) – are not needed.

The computer control program is written using a 'normal' computer and downloaded into the embedded computer. The software program is stored in a ROM chip (see *Section 8*) and activates when the machine is switched on.

Washing machine

Inputs: Water flow sensors, water level sensors, temperature sensors, panel switches, door switch.

Process: Stored programs for different wash cycles, eg woollens, cotton, etc. Each program controls the water temperature and level, and the timing and sequence of the wash, rinse and spin cycles.

Outputs: Switches to operate water pumps and valves, water heaters, the drum motor and indicator lights.
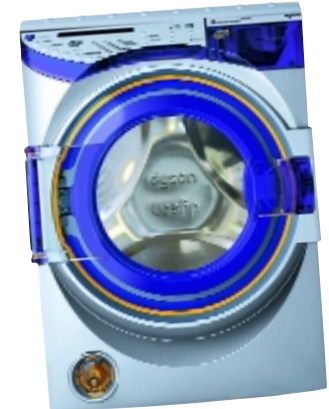
Robotic arm

Inputs: Movement coordinates entered at a keyboard or memorised as a skilled worker guides the arm in a learning process, pressure sensors, movement sensors, proximity switches.

Process: Arm follows a pattern of movements held in memory. Switches operate the tools. Sensors on the arm detect and feedback information on its position in relation to the job.

Outputs: Switches to control movement (electric motors, pneumatic valves or hydraulic pumps) and to operate tools being used by the arm.

Digital camera

Inputs: Light sensor, push buttons, dials, focus sensor.

Process: Calculate light level and adjust shutter speed and aperture (size of hole allowing light in) according to film speed. Calculate focus points to produce sharp image.

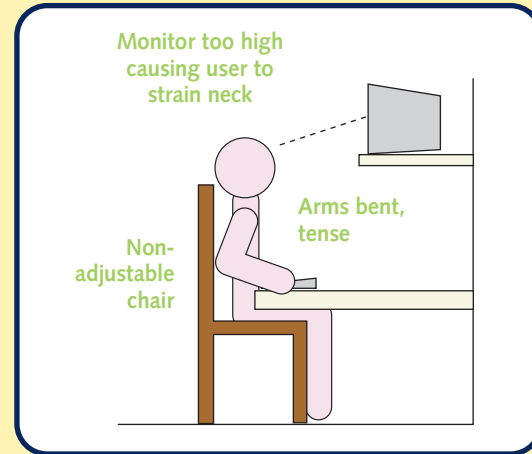Outputs: Shutter actuator, memory storage, lens focusing motor, LCD display.

? *Give one input and one output for a computer-controlled central heating system.*
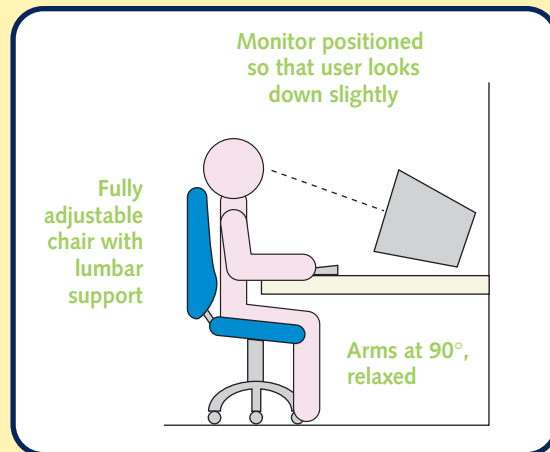
People can suffer from ill health when they work with computers for long periods. It is important that you understand the risks and know how to reduce them.

Room and furniture design

The safest environment is a tidy and well-organised room. Electrical cables should not trail across the floor, and food and drinks should be kept well away from the computer and keyboard. Computers should be positioned so that sunlight from the window does not reflect on the screen.

Monitor too high causing user to strain neck

Arms bent, tense

Non-adjustable chair

How not to work at a computer!

Monitor positioned so that user looks down slightly

Fully adjustable chair with lumbar support

Arms at 90°, relaxed

The correct position for working at a computer

Sitting at the computer for long periods of time can lead to aches and pains in the neck, shoulders, back and arms. You should sit upright with your feet flat, the upper arms straight down parallel with the body, and the lower arms horizontal. Adjustable chairs that give the maximum support for the back are also best.

HINT
When using the computer for more than an hour, take regular breaks, stand up, stretch or move about and focus your eyes on distant objects through the window.

RSI (repetitive strain injury)

This is an ailment that can affect people using the keyboard for long periods. Workers suffer from neck, arm and hand pains and the condition can be very serious. RSI is also known as WRULD (work-related upper limb disorder).

Keyboards

The keyboard layout is over one hundred years old and was designed to reduce the typing speed so that the letters on the old mechanical typewriters did not jam. Modern keyboards still have the same layout but are ergonomically designed, to reduce the neck, arm and hand pains that typists may get when using the keyboard for long periods.

Monitors

Using a monitor for long periods can lead to eye strain and headaches. Large monitors with high resolutions are easier on the eyes. All new monitors must comply with EU standards, which ensure that radiation emission is as low as possible.

Electrical safety

Computers run from the mains electricity supply and must be treated with care. When the case of the computer is removed to fit a new drive or additional memory, the power cable should always be disconnected first.

Law

In 1992, the Health and Safety (Display Screen Equipment) Regulations came into force. This legislation requires employers to check that the workstation and the working environment is safe and, if employees spend a significant time at their workstation, the employer must pay for eye tests.

Fire

Should a computer or monitor catch fire, use a powder-based or CO$_2$ (carbon dioxide) extinguisher – never use water on electrical devices.

Staying healthy

Use a chair with a backrest set to the correct height. Use an ergonomically-designed keyboard and good lighting.

What steps should an office manager take when an employee complains of eye strain and headaches when working at the computer?