Cambridge

OL- IGCSE

ICT

CODE: (0417)

Chapter 05

The effect of using IT

5.1 Microprocessor-controlled devices

5.1.1 Effects of using microprocessor-controlled devices in the home

Using microprocessor-controlled devices in the home can have positive and negative effects on our:

» Lifestyle » Leisure time » Physical fitness » Data security » Social interaction.

Many common household devices are now fitted with microprocessors to control a large number of their functions. The devices fall into two main groups:

Labour-saving devices (group 1):

» Automatic washing machines » Microwave ovens » Cookers
» Automatic dishwashers » Robotic vacuum cleaners » Bread-making machines » Smart fridges and freezers.

Other devices (group 2):
» Alarm clocks » Television sets » Central heating and air-conditioning systems
» Home entertainment systems » Mobile phones and tablets.

Lifestyle, leisure time and physical fitness Table 5.1 summarises the effects of microprocessor-controlled labour-saving devices on a person's lifestyle, leisure time and physical fitness.

Table 5.2 shows some of the more general ways in which all microprocessor-controlled devices can affect our lives.

▼ **Table 5.1** Advantages and disadvantages of microprocessor-controlled labour-saving devices

Advantages	Disadvantages
» People no longer have to do manual tasks at home. » They give people more time for leisure activities, hobbies, shopping and socialising. » There is no longer a need to stay home while food is cooking or clothes are being washed. » It is possible to control ovens and automatic washing machines, for example, using smartphones – a web-enabled phone allows devices to be switched on or off while the owner is out. » Automated burglar alarms give people a sense of security and well-being as they give a very sophisticated level of intruder warning at all times. » Smart fridges and freezers can lead to more healthy lifestyles (they can automatically order fresh food from supermarkets using their internet connections) as well as prevent food waste.	» Labour-saving devices can lead to unhealthy lifestyles (because of the lack of exercise) – people can become less fit if they just lie around at home while the devices carry out many of the previous manual tasks. » They tend to make people rather lazy because there is a dependence on the devices. » There is a potential to lose household skills. » As with any device which contains a microprocessor and can communicate using the internet, there is the risk of cybersecurity threats (this is discussed in more depth later).

▼ **Table 5.2** General advantages and disadvantages of using all microprocessor-controlled devices

Advantages	Disadvantages
» Microprocessor-controlled devices save energy because they are far more efficient and can, for example, switch themselves off after inactivity for a certain time period. » It can be easier 'programming' these devices to perform tasks rather than turning knobs and pressing buttons manually (for example, QR codes on the side of food packaging can simply be scanned and the oven automatically sets the cooking programme).	» The devices lead to a more wasteful society – it is usually not cost effective to repair circuit boards once they fail; the device is then usually just thrown away. » They can be more complex to operate for people who are technophobes or who are not very confident around electronic devices. » Leaving some devices on standby (such as televisions or satellite receivers) is very wasteful of electricity.

Data security issues

As mentioned in Table 5.1, having a microprocessor-controlled device connected to the internet can lead to cybersecurity issues. If you are able to communicate remotely with devices in your home, then so can a hacker. Any household device which can be remotely controlled could allow a hacker to gain personal data about you. These devices are often set with a default (or no) password, making it easy for cybercriminals to obtain personal details.

Social interactions

There are both positive and negative impacts of microprocessor-controlled devices on social interactions to consider. Devices, such as smartphones, smart televisions or tablets allow people to communicate from home using VoIP (a type of video conferencing), emails or chat rooms. The positive aspects include:

» Easier to make new friends using chat rooms
» Easier to find people who share similar interests/hobbies
» Less expensive to keep in touch using VoIP technology.

But the negative aspects include:
» People do not meet face-to-face as much (social isolation)
» A lack of social interaction may make people more anxious of meeting people in real life
» People behave differently when interacting online – sometimes they can be ruder or more aggressive, and cyberbullying is a real problem, particularly for young people.

5.1.2 Monitoring and controlling transport

The use of microprocessors in transport systems is becoming more and more widespread

Control of smart road systems and smart signs

Many **modern motorways** are now called smart motorways. This is because the monitoring and control of the traffic and/or the information displayed on the motorway signs is controlled by a central computer system.

Rail and airline network control systems

Safely coordinating the large number of trains and aeroplanes entering and leaving stations and airports is a complex task, but computerised monitoring systems make this possible. It is possible to run a more efficient timetable under total computer control.

▼ **Table 5.3** Advantages and disadvantages of transport monitoring and control systems

Advantages	Disadvantages
Smart motorways constantly adapt to traffic conditions, reducing traffic jams and minimising everyone's journey time.	A hacker could gain access to the computerised system and cause disruption.
Transport systems are more efficient – more cars, trains and aeroplanes can use the transport network, allowing for more regular services.	If the computer system fails then the whole transport system could be brought to a standstill.
Traffic offences (for example, driving in the wrong lane) can be automatically penalised using ANPR.	Poorly designed systems could compromise safety.
Stolen cars and criminals can be spotted using ANPR.	ANPR systems mean that innocent people's movements can easily be tracked. Who has access to that data?
Computerised control systems minimise human error, which reduces the rate of accidents.	

Autonomous vehicles in transport

Driverless (autonomous) vehicles are increasing in number every year. These are very complex robots, but the big problem is not really the technology (because problems will be solved over time) – it is human perception. It will take a large leap of faith for humans to ride in an autonomous car or an aeroplane with no pilot.

Autonomous cars, buses and vans

In this section, we will consider autonomous cars as our example. Autonomous cars use sensors, cameras, actuators and microprocessors (together with very complex algorithms) to carry out their actions safely.

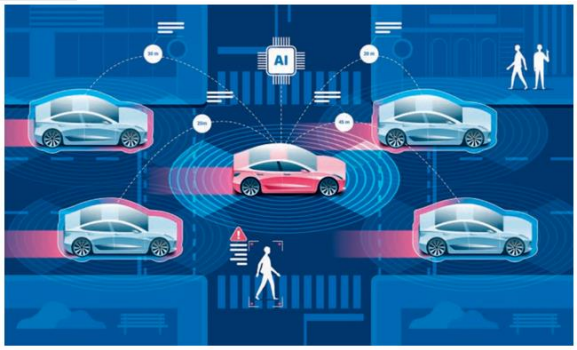
Microprocessors process the data received from cameras and sensors and send signals to actuators to perform physical actions.

Security and safety when using autonomous vehicles

Autonomous vehicles use sensors, cameras and microprocessors to 'understand' their immediate environment. These vehicles run using complex software systems and a large number of external sensors. This makes such vehicles rather vulnerable to cybercriminals. A hacker may not even have to break into the vehicle's control system; they may be able to cause many problems by blocking sensor information or sending false information back to the vehicle.

▼ **Table 5.4** Advantages and disadvantages of autonomous vehicles

Advantages	Disadvantages
Safer because human error is removed, leading to fewer accidents	Very expensive system to set up in the first place (high technology requirements)
Better for the environment because vehicles will operate more efficiently	The ever-present fear of hacking into the vehicle's control system
Reduced traffic congestion (humans cause 'stop-and-go' traffic known as 'the phantom traffic jam' – autonomous vehicles will be better at smoothing out traffic flow, reducing congestion in cities)	Security and safety issues (software glitches could be catastrophic; software updates would need to be carefully controlled to avoid potential disasters)
Increased lane capacity (research shows autonomous vehicles will increase lane capacity by 100% and increase average speeds by 20%, due to better braking and acceleration responses together with optimised distance between vehicles)	The need to make sure the system is well-maintained at all times; cameras need to be kept clean so that they do not give false results; sensors could fail to function in heavy snowfall or blizzard conditions (radar or ultrasonic signals could be deflected by heavy snow particles)
Reduced travel times (for the reasons above) therefore less commuting time	Driver and passenger reluctance of the new technology
Stress-free parking for motorists (the car will find car parking on its own and then self-park)	Reduction in the need for taxis could lead to unemployment (imagine New York without its famous yellow cabs!)



▲ **Figure 5.2** Autonomous car sensors

Autonomous trains

Autonomous trains make use of a system called **LiDaR** (Light Detection and Ranging); LiDaR uses lasers which build up a 3D image of the surroundings. Other sensors (such as proximity sensors on train doors) and cameras (including infrared cameras) are all used for various purposes to help control the train and maintain safety.

Table 5.5 considers some of the advantages and disadvantages specific to autonomous trains.

Table 5.5 Advantages and disadvantages of autonomous trains

Advantages	Disadvantages
Improves the punctuality of the trains	The ever-present fear of hacking into the vehicle's control system
Reduced running costs (fewer staff are required)	System does not work well with very busy services (at the moment)
Improved safety because human error is removed	High capital costs and operational costs initially (that is, buying the trains, expensive signalling and control equipment and the need to train staff)
Minimises energy consumption because there is better control of speed and minimal delays (trains stuck in stations still use energy)	Ensuring passenger behaviour is acceptable, particularly during busy times (for example, jamming doors open on trains, standing too near the edge of platforms, and so on)
It is possible to increase the frequency of trains (automated systems allow for shorter times between trains)	Passenger reluctance of the new technology
It is easier to change train scheduling (for example, more trains during busier times)	No drivers mean there will be a need for CCTV to monitor railway stations

Autonomous (pilotless) aeroplanes

Autonomous (pilotless) aeroplanes would make even more extensive use of sensors, actuators and microprocessors to control all stages of the flight. Some of the main features of a control system on a pilotless aeroplane would include:

» Sensors to detect turbulence to ensure smooth flights

» An increase in self-testing of all circuits and systems

» Sensors that would automatically detect depressurisation in the cabin, therefore allowing for quick stabilisation of the aeroplane

» Use of GPS for navigation and speed calculations

» Use of actuators to control,

Table 5.6 Advantages and disadvantages of pilotless aeroplanes

Advantages	Disadvantages
Improvement in passenger comfort (reasons given earlier)	Security aspects if no pilots on-board (for example, handling terrorist attacks)
Reduced running costs (fewer staff are required)	Emergency situations during the flight may be difficult to deal with
Improved safety (most crashes of aeroplanes have been attributed to pilot-induced errors)	Hacking into the system (it could be possible to access flight control via the aeroplane's entertainment system)
Improved aerodynamics at the front of the aeroplane because there would no longer be the need to include a cockpit for the pilots	Passenger reluctance to accept the new technology
	Software glitches (recent software issues with modern aeroplanes have highlighted that software glitches sometimes only surface a few years later, causing devastating results)

5.2 Potential health problems related to the prolonged use of IT equipment

Using IT equipment for long periods of time can impact on a user's health.

▼ **Table 5.7** Health risks of using IT equipment

Health risk	Causes of health risk	Elimination or reduction of health risk
Back and neck strain	Caused by sitting in front of a computer screen for long periods of time	» Use fully adjustable chairs to give the correct posture » Use foot rests to reduce posture problems » Use tiltable screens, raised to the correct height, to ensure the neck is at the right angle
Repetitive strain injury (RSI)	Damage to fingers and wrists caused by continuous use of a keyboard or repetitive clicking of mouse buttons, for example	» Ensure correct posture is maintained (for example correct angle of arms to the keyboard and mouse) » Make proper use of a wrist rest when using a mouse or keyboard » Take regular breaks (+ exercise) » Make use of ergonomic keyboards » Use voice-activated software if the user is prone to problems using a mouse or keyboard
Eyestrain	Caused by staring at a computer screen for too long or by having incorrect lighting in the room (causing screen reflections)	» If necessary, change screens to LCD if older CRT screens are still used » Take regular breaks (+ exercise) » Make use of anti-glare screens if the room lighting is incorrect (or use window blinds to cut out direct sunlight) » Users should have their eyes tested on a regular basis (middle vision glasses should be prescribed if the user has a persistent problem with eye strain, dry eyes, headaches, etc.)
Headaches	Caused by incorrect lighting, screen reflections, flickering screens, and so on	» Make use of anti-glare screens if the room lighting is incorrect (or use window blinds to cut out reflections which cause squinting, leading to headaches) » Take regular breaks (+ exercise) » Users should have their eyes tested on a regular basis (middle vision glasses should be prescribed if the user has a persistent problem with headaches)
Ozone irritation	Caused by laser printers in an office (symptoms are dry skin and respiratory problems)	» Proper ventilation should exist to lower the ozone gas levels to acceptable values » Laser printers should be housed in a designated printer room » Change to using inkjet printers where possible

Revision questions

1. March/2022/Paper_12/No.9(a_ c)
The introduction of computers into the work place has affected job patterns.
(a) Explain what is meant by part-time working.
(b) Explain what is meant by compressed hours working.
(c) Employees working in an office use computers for prolonged periods of time.
Describe three items that an employee should be provided with to help reduce the health problems related to prolonged use of computers.

2. June/2022/Paper_11/No.8
When using computers people can suffer from Repetitive Strain Injury (RSI).
(a) Describe the term RSI. Include in your answer the causes of RSI.
(b) Identify three methods of reducing the effects of RSI.

3. June/2022/Paper_12/No.10
The prolonged use of computers can cause several health problems particularly when sitting down and using monitors.
Discuss the strategies that you have developed to minimise health risks which only relate to sitting down and using a monitor.

4. June/2022/Paper_13/No.6(a_ b)
Eye strain is one of the health issues associated with using computers.
(a) Explain three causes of eye strain when using computers.
(b) Identify four methods of reducing the effects of eye strain.

5. Nov/2022/Paper_12/No.9(a, b)
Many organisations store data in the cloud.
(a) Explain what is meant by the ICT term cloud.
(b) Explain the issues of storing data in the cloud.

6. Nov/2022/Paper_12/No.13
Computers are being used in offices.
Describe how the use of computers has affected the work of employees and their working patterns.

7. Nov/2022/Paper_13/No.15(c)

(c) Tick (✓) the most appropriate working pattern to match the following statements.

	Compressed hours (✓)	Flexible hours (✓)	Job sharing (✓)	Part-time working (✓)
An employee works a full day but negotiates with the employer the start and end times				
An employee works the same number of hours as a full week but in fewer days				
An employee works for fewer hours than a full-time employee				

1. Nov/2021/Paper_11/No.2

Circle **two** jobs where there has been a decrease in employment as a direct result of the introduction of computers.

Bus drivers	Car production workers	Delivery drivers for retail stores	Fishermen
Payroll workers	Programmers	Teachers	Website designers

[2]

2. Nov/2021/Paper_11/No.6

As a student you often use a computer screen. This could be a screen on a desktop computer, a laptop computer or even a smartphone.

Evaluate your use of computer screens, in terms of health risks, and explain any strategies you use to minimise these health risks.

3.June/2021/Paper_11/No.9

A company operates from 08:00 to 19:00, Monday to Friday. Full-time employees work a 40-hour week, starting at 09:00 and finishing work at 17:00.

For each of the times worked by an employee, write down the most appropriate working pattern.

(a) An employee works from 09:00 to 13:00, Monday to Friday.

(b) An employee works from 09:00 to 19:00, Monday to Thursday.

(c) The work of two employees combined is a 40-hour week; each work for two full days and a half day.

(d) An employee works a full 8-hour day but has negotiated with his employer to complete this at some point between 08:00 and 19:00, each day.

4. June/2021/Paper_12/No.10

Describe the advantages, to both the company and employees, of changing work patterns due to the introduction of computers.

5. June/2021/Paper_13/No.2

Circle **two** jobs where there has been an increase in employment as a direct result of the introduction of computers.

Car production workers	Cleaning staff	Delivery drivers for retail stores	Medical staff
Payroll workers	Secretaries	Teachers	Website designers

6. June/2021/Paper_13/No.15

Streaming movies and music is replacing downloading or purchasing a physical copy of the files.

Describe the advantages and disadvantages of streaming files rather than using other methods.

7. Nov/2020/Paper_13/No.10

The use of ICT in organisations has changed the way in which employees work.

(a) Describe, giving an example, what is meant by compressed hours.

(b) Describe, giving an example, what is meant by flexible working.

8.June/2020/Paper_13/No.10

The modern home relies heavily on microprocessor-controlled devices. One of the benefits is that a worker is able to return home to a warm house having set the heater control to switch on at a certain time.

(a) Describe four benefits in terms of lifestyle changes that this has produced for the users of such devices.

(b) The worker has set the heater control to switch on at 16:00 for two hours.

Explain how the microprocessor can operate the automatic heater to turn on and off at the correct times.