6.2 ROBOTICS

- Robotics is a branch of computer science that brings together the design, construction and operation of robot

- factories
  - welding parts together
  - spray-painting panels on a car
  - fitting windscreens to cars
  - cutting out metal parts to a high precision
  - bottling and labelling plants
  - warehouses (automatic location of items)

6.2 ROBOTICS

- Robotics is a branch of computer science that brings together the design, construction and operation of robot

▲ **Figure 6.13** Robot carpet sweeper

» in the home
  - **autonomous** floor sweepers (see Figure 6.13)
  - autonomous lawn mower
  - ironing robots (for example, 'dressman')
  - pool cleaning
  - automatic window cleaners
  - entertainment ('friend' robots)

6.2 ROBOTICS

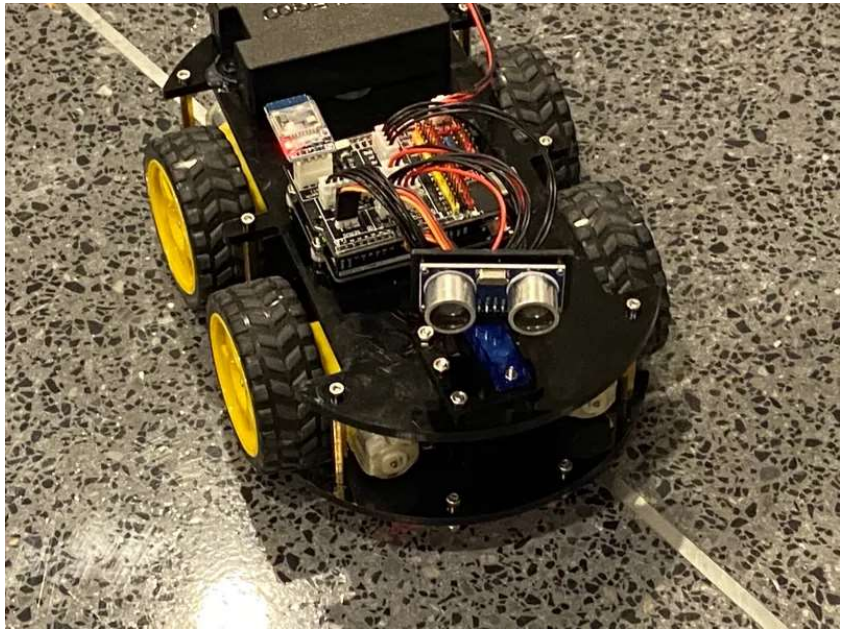
- Robotics is a branch of computer science that brings together the design, construction and operation of robot

▲ **Figure 6.14** Reconnaissance drone

» drones
  - unmanned aerial vehicles (UAVs) are drones that are either remotely controlled or totally autonomous using embedded systems
  - can be used in reconnaissance (for example, taking aerial photographs)
  - can be used to make parcel deliveries (for example, Amazon).

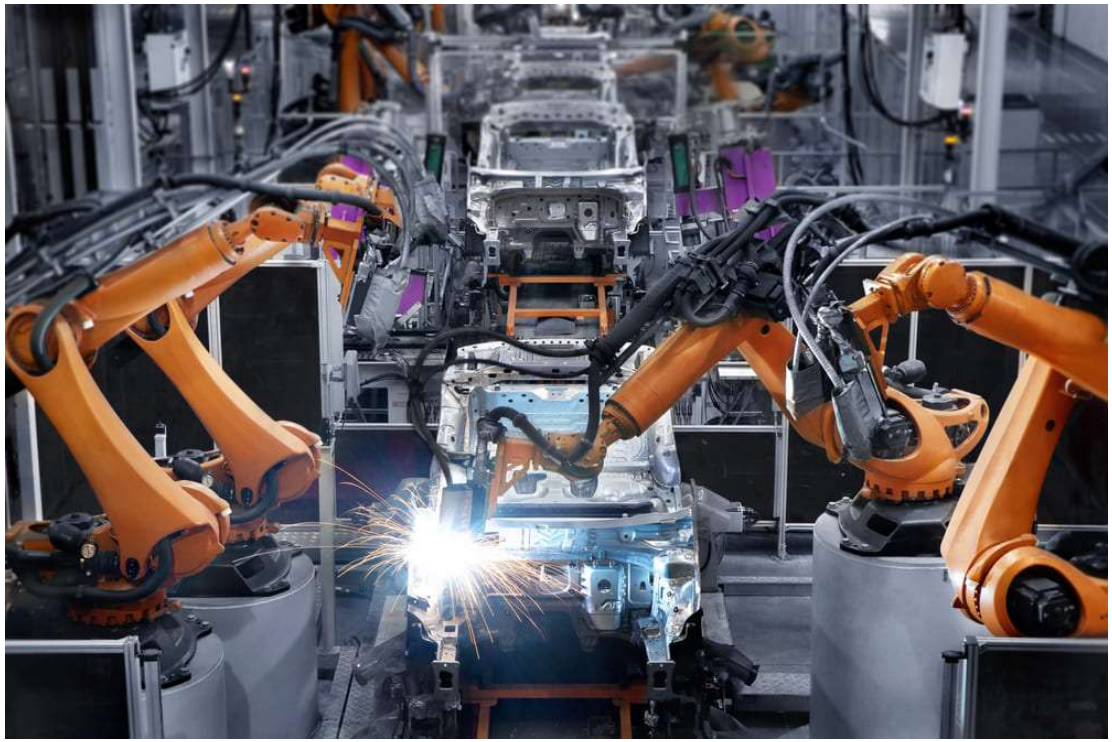
6.2.2 CHARACTERISTICS OF A ROBOT

- Consists of several electronic parts
  - Ability to sense their surroundings:
    - this is done via sensors (such as light, pressure, temperature, acoustic, and so on)
    - sensors allow a robot to recognise its immediate environment and gives it the ability to determine things like size, shape or weight of an object, detect if something is hot or cold, and so on; all sensor data is sent to a microprocessor or computer.
  - Several output parts
    - Actuator, switch, end effectors



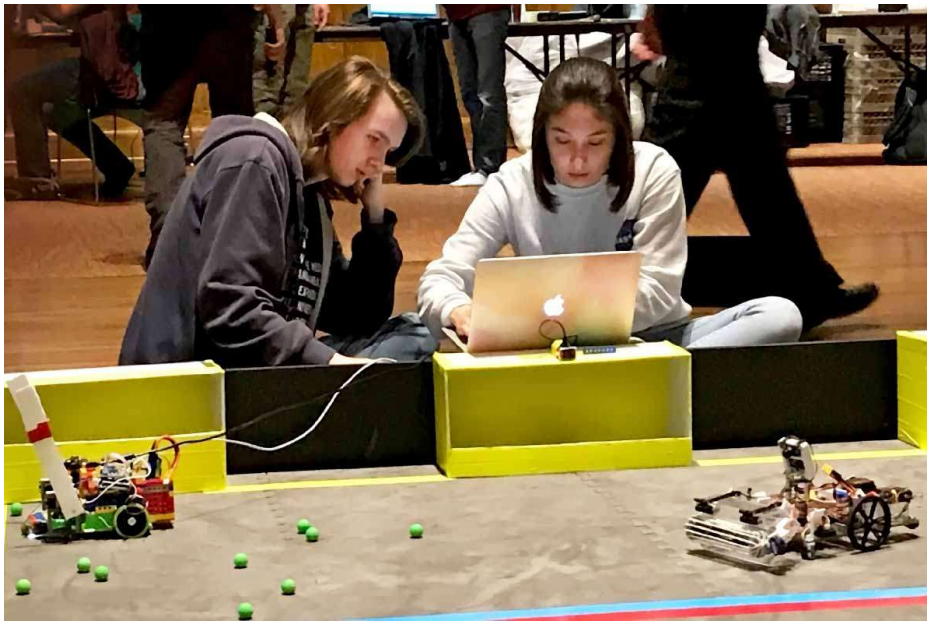
6.2.2 CHARACTERISTICS OF A ROBOT

- Have a degree of movement:
  - they can make use of wheels, cogs, pistons, gears (etc.) to carry out functions such as turning, twisting, moving backwards/forwards, gripping or lifting
  - can make use of end effectors (different attachments to allow them to carry out specific tasks such as welding, spraying, cutting or lifting)



6.2.2 CHARACTERISTICS OF A ROBOT

- Programmable:
  - Robots are programmable to allow the robots to do certain tasks
  - Robots can be reprogramed to do a new task
  - It requires technicians and programmer to setup



6.2.2 CHARACTERISTICS OF A ROBOT

- Robots and AI
  - Not all robots have AI, since most of robots tend to do repetitive tasks rather than making decision on the input
- Physical robots and software robots
  - Software robots are chat bot, search engine bots and WebCrawlers
  - Software robots are not true robots
- Physical robots
  - Independent robots
    - Have no human control (autonomous)
  - Dependent robots
    - Have a human who is controlling directly the robot

6.2.3 THE ROLE OF ROBOTS AND THEIR ADVANTAGES AND DISADVANTAGES

- Industry: robots in factories

Advantages	Disadvantages
robots are capable of working in conditions that may be hazardous to humans	robots can find it difficult to do 'non-standard' tasks (for example, windscreen being fitted to a car is cracked)
robots work 24/7 without the need to stop	
robots are less expensive in the long run (since there will be fewer salaries to pay)	robots can lead to higher unemployment amongst manual labour tasks
robots are more productive than humans (higher productivity)	there is a risk of deskilling when robots take over certain tasks (for example, welding and paint spraying)
although not necessarily more accurate, robots are more consistent	
robots are better suited to boring, repetitive tasks than humans (therefore less likely to make mistakes)	factories can now be moved to anywhere in the world where operation costs are lower (leading again to unemployment in some countries)
there will be less cost in heating and lighting (robots don't need good light or warmth)	robots are expensive to buy and set up in the first place

6.2.3 THE ROLE OF ROBOTS AND THEIR ADVANTAGES AND DISADVANTAGES

- Transport: autonomous cars and buses (Tesla)

Advantages of autonomous vehicles	Disadvantages of autonomous vehicles
safer since 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 since 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 optimized 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 don't 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 to use 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!)

6.2.3 THE ROLE OF ROBOTS AND THEIR ADVANTAGES AND DISADVANTAGES

▲ **Figure 6.19** Autonomous train (London Transport)

- Transport: autonomous trains

Advantages of autonomous trains	Disadvantages of autonomous trains
this 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 doesn't work well with very busy services (at the moment)
improves safety since 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 since there is better control of speed and an optimum service requires less energy (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 to use 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

6.2.3 THE ROLE OF ROBOTS AND THEIR ADVANTAGES AND DISADVANTAGES

- Industry: Autonomous (unpiloted) airplanes

Advantages of pilotless airplanes	Disadvantages of pilotless airplanes
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 airplanes have been attributed to pilot-induced errors)	hacking into the system (it might be possible to access flight controls)
improved aerodynamics at the front of the airplane since there would no longer be the need to include a cockpit for the pilots	passenger reluctance to use the new technology
	software glitches (recent software issues with modern airplanes have highlighted that software glitches can have devastating results)