# Microcontrollers in everyday products

**LEARNING INTENTION**

We are learning where microcontrollers are used in commercial and industrial products, and why.

**SUCCESS CRITERIA — I CAN**

- ☐ describe what a microcontroller is
- ☐ give examples of domestic, commercial and industrial uses
- ☐ state advantages of microcontroller control
- ☐ show a microcontroller as the process in a sub-system diagram

## What is a microcontroller?

A microcontroller is a small computer on one chip. It has a processor, memory and input/output pins.

It runs a stored program. The program reads the inputs, makes decisions and switches the outputs.

## Where are they used?

| Area | Examples | What the microcontroller does |
|---|---|---|
| Domestic | washing machine, microwave, central heating | times cycles, reads buttons and sensors |
| Commercial | vending machine, ticket barrier, lift | counts coins, checks tickets, controls motors |
| Industrial | conveyor, packaging line, wind turbine | monitors sensors, controls motors and alarms |
| Transport | level crossing, traffic lights | sequences lights with time delays |

## Why use a microcontroller?

**Reprogrammable**
Change how it works by changing the program.

**Fewer parts**
One chip replaces many gates and timers.

**Smaller and cheaper**
Less board space and cost when made in large numbers.

**Complex control**
Can count, time and make many decisions.

**SHORT CIRCUIT**

**× WHAT EXAMINERS SAW**

Some candidates gave vague answers such as 'it is better' or 'it is easier' when asked for an advantage of a microcontroller.

**✓ THE FIX**

Name a specific advantage and link it to the product: 'The program can be changed, so the wash times can be updated without new hardware.'

Microcontroller questions in recent papers.

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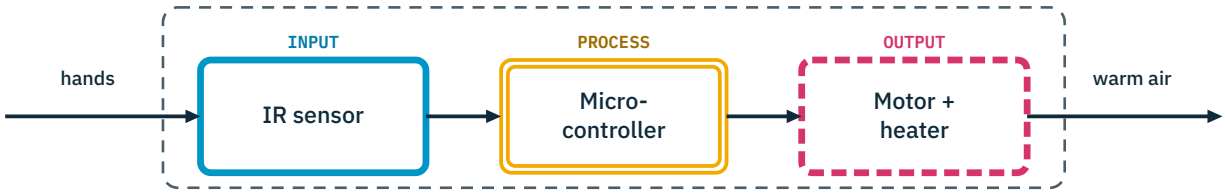
## Microcontroller as the process

WORKED EXAMPLE **Sub-system diagram for a hand dryer**

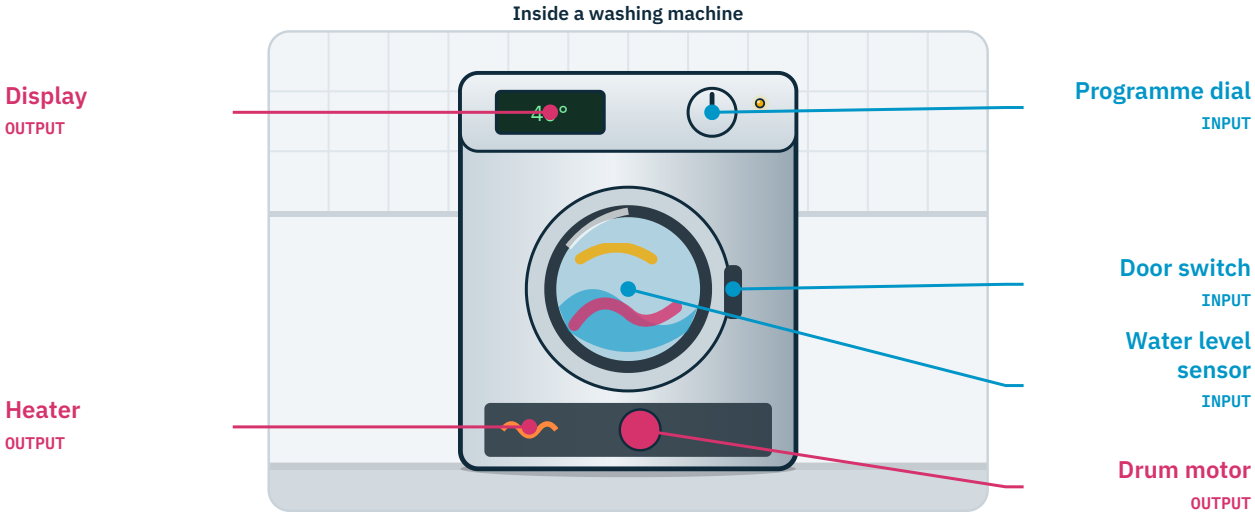
| 1 GIVEN | 2 FIND | 3 FORMULA | 4 SUBSTITUTE | 5 ANSWER + UNIT |
|---|---|---|---|---|
| hand dryer switches on when hands are detected runs for 20 s | sub-systems | input → process → output | Input: infrared sensor<br>Process: microcontroller (timing)<br>Output: motor and heater | **IR sensor → microcontroller → motor + heater** |

The microcontroller is the process sub-system. It also does the timing.




Hand dryer sub-system diagram

## One chip, many inputs and outputs




The microcontroller is the process: it runs the wash programme

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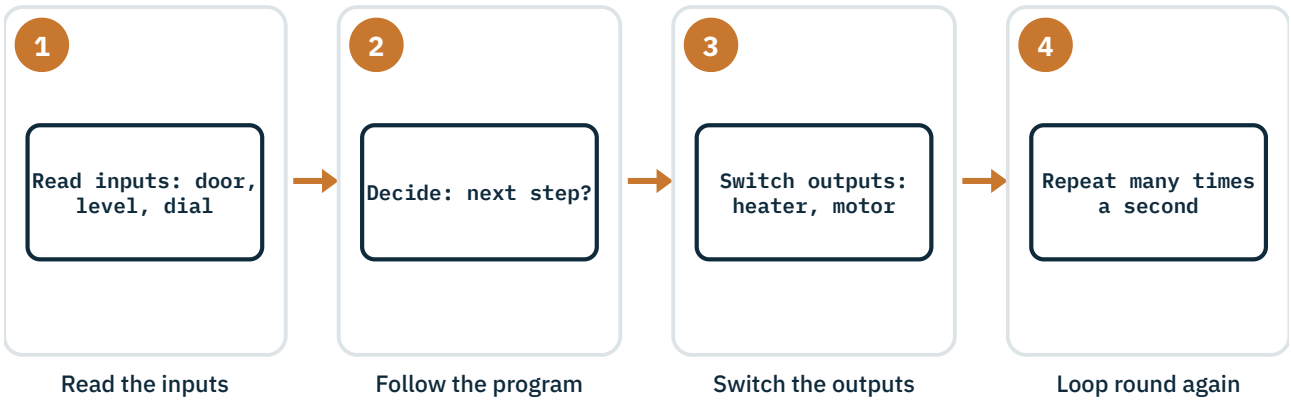
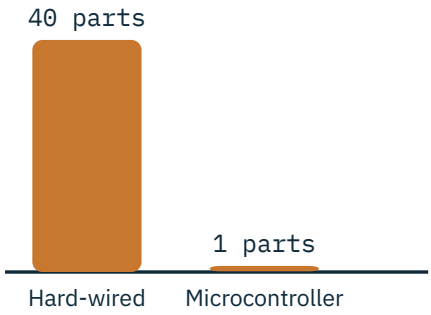
## WHAT THE MICROCONTROLLER DOES ALL DAY




A timed sequence: parts needed (typical)

A hard-wired circuit with timers and gates needs many parts. A microcontroller does the same job on one chip, and can be reprogrammed.

### WORKED EXAMPLE Inputs and outputs of a washing machine

| 1 GIVEN | 2 FIND | 3 FORMULA | 4 SUBSTITUTE | 5 ANSWER + UNIT |
|---|---|---|---|---|
| domestic washing machine | two inputs, two outputs | inputs: what it senses/reads<br>outputs: what it drives | inputs: door switch, water level sensor<br>outputs: drum motor, heater | **2 in, 2 out** |

### WORKED EXAMPLE An advantage, linked

| 1 GIVEN | 2 FIND | 3 FORMULA | 4 SUBSTITUTE | 5 ANSWER + UNIT |
|---|---|---|---|---|
| vending machine (fictional Glenbrae Snacks) | advantage of a microcontroller | name it<br>link it to the product | reprogrammable<br>prices can be changed in the program without new parts | **Reprogrammable** |

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## REAL ENGINEERING · CAIRNLOCH SKI CENTRE

The snow cannons at Cairnloch (fictional) are run by microcontrollers. Each reads air temperature and humidity.

Engineers can update the program from the control room when the snow-making rules change, without rewiring any cannon.



## PROBE · QUICK CHECKS

1. What is a microcontroller? _____
2. Name one industrial use. _____
3. One advantage? _____

## EXAM READY · 6 MARKS

**1** **State** two examples of domestic products controlled by a microcontroller. **[2]**

**2** **Describe** one advantage of using a microcontroller in a vending machine. **[1]**

**3** A car-park barrier lifts when a ticket is detected. **Complete** the sub-system diagram. **[3]**

