

# Open/Closed Loop Systems

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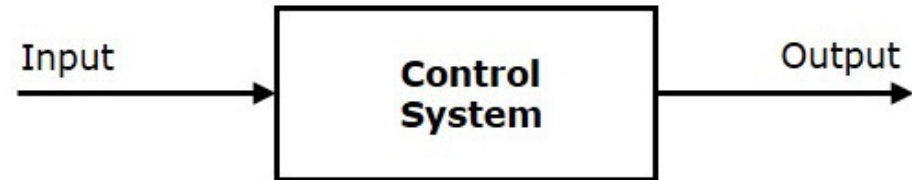
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# What is a control system?

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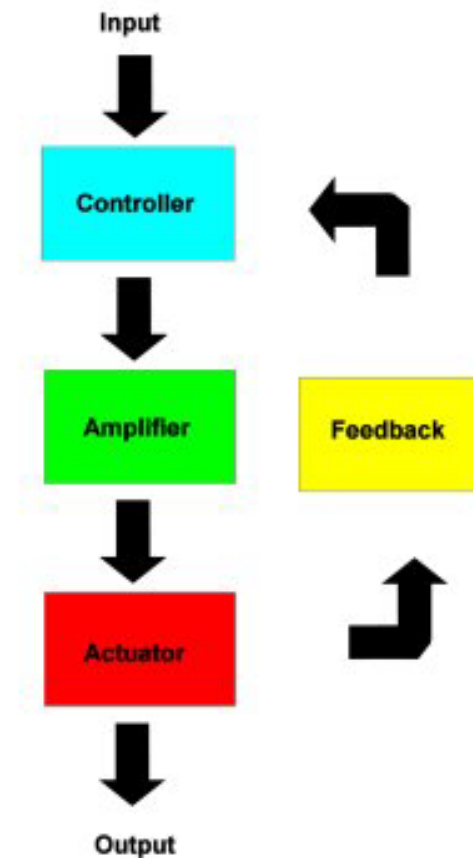
- A **control system** is a system that manages, directs, or regulates the behaviour of other systems to achieve a desired output.
- A control system will communicate with sensors and actuators to fulfil a desired function



# Parts of a control system

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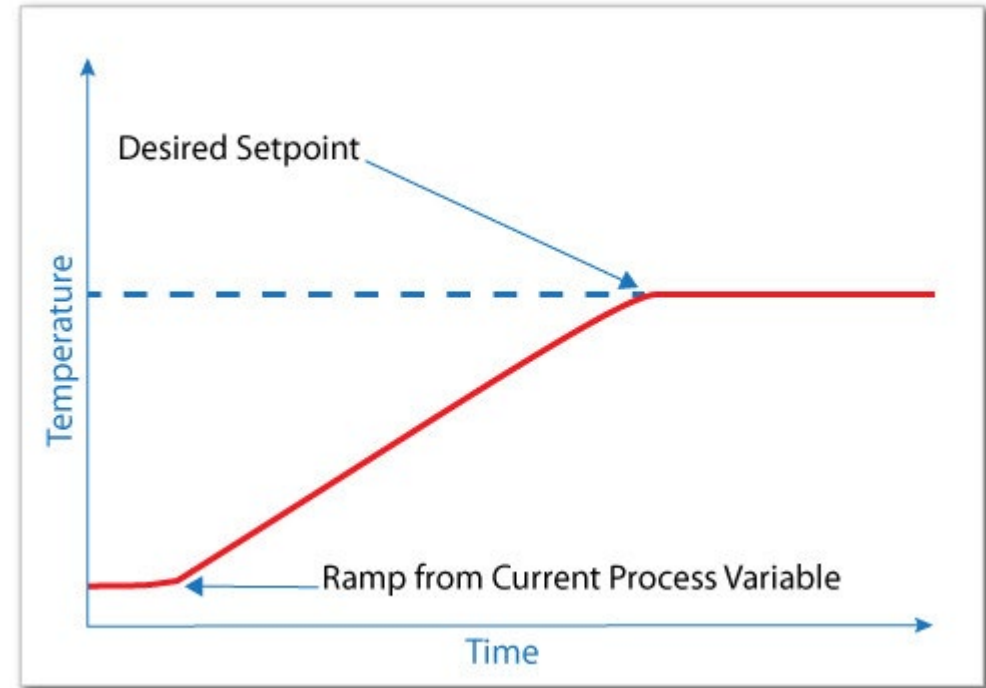
- Input (reference signal)
- Controller
- Process/System
- Actuator
- Output
- Feedback (Only in Closed-Loop Systems)
- Disturbance



# Input (reference signal)

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- The desired value or setpoint that the system aims to achieve.
- Example: Setting the temperature on an air conditioner.



# Controller

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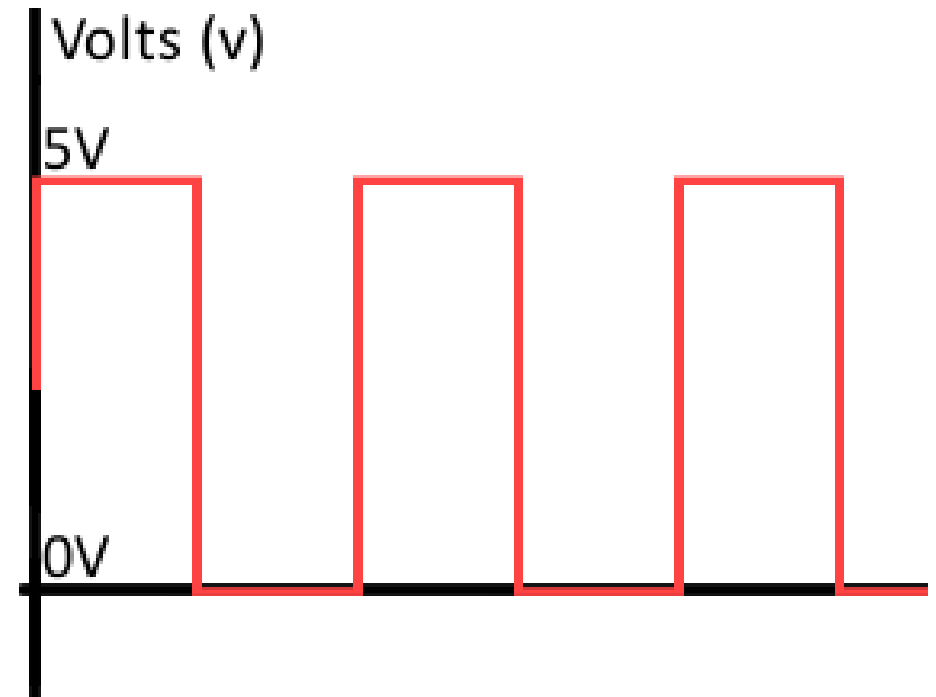
- The decision-making unit that processes the input and determines how to control the system.
- Example: A thermostat in a heating system.
- In our PLC systems this is the PLC



# Process/System

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- The actual system being controlled.
- This is just the output value or code, it isn't the actual movement
- Example: A movement signal sent to a motor or an analogue signal sent to a heater



# Output (Actuator)

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- Converts the controller's output signal into physical action.
- Example: A motor in a robotic system or a valve in a hydraulic system.



# Output

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- The actual response or result of the system after processing.
- Example: The adjusted room temperature in an HVAC system.

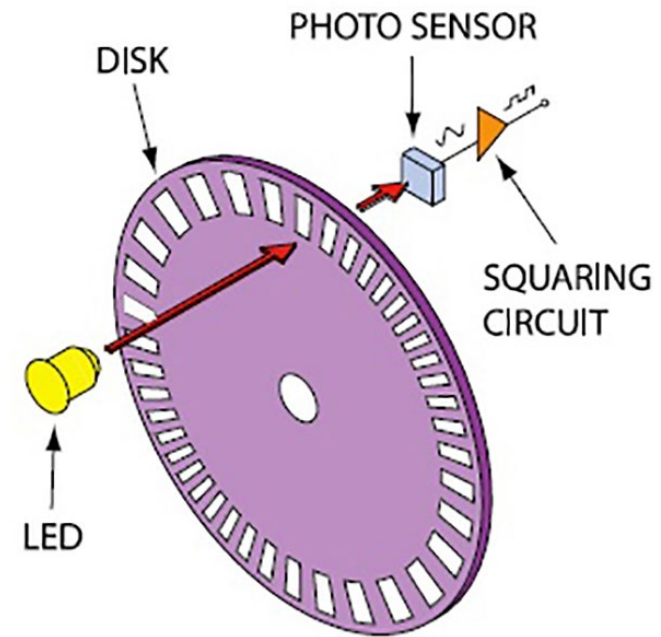




# Feedback (Only in Closed-Loop Systems)

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- A sensor or measuring device that continuously monitors the output and sends data back to the controller.
- This ensures the process has reached the correct value
- Example: A temperature sensor in an air conditioner.



# Disturbance

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- External factors that can affect system performance.
- Example: Wind affecting a drone's flight stability.



# Types of Control Systems

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- There are two ways control systems are set up:
  - Open Loop Systems
  - Closed Loop Systems

**Open-Loop Control System**

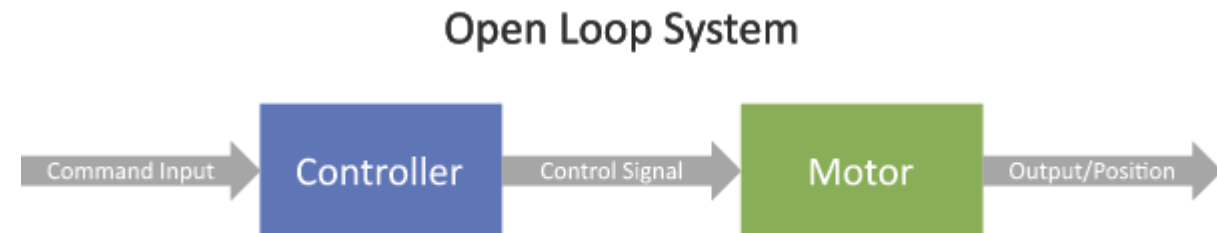
**Versus**

**Closed-Loop Control System**

# Open Loop Systems

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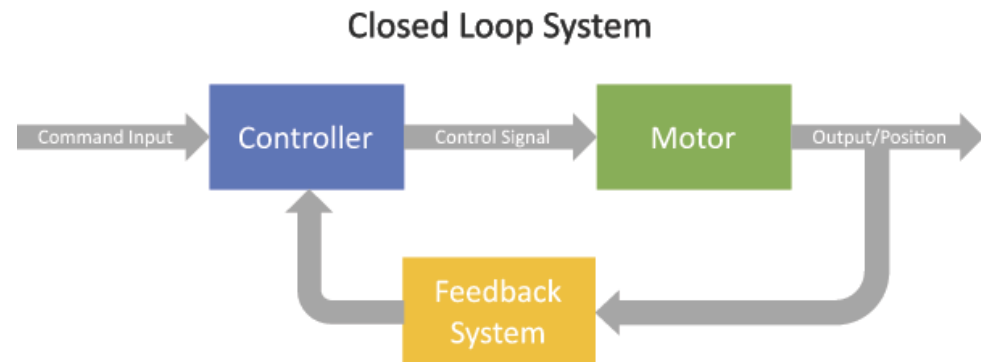
- Works without feedback.
- Example: Microwave oven (fixed heating time, no temperature adjustment).
- Advantages: Simple, cost-effective, easy to design.
- Disadvantages: No error correction, less accuracy.



# Closed Loop Systems

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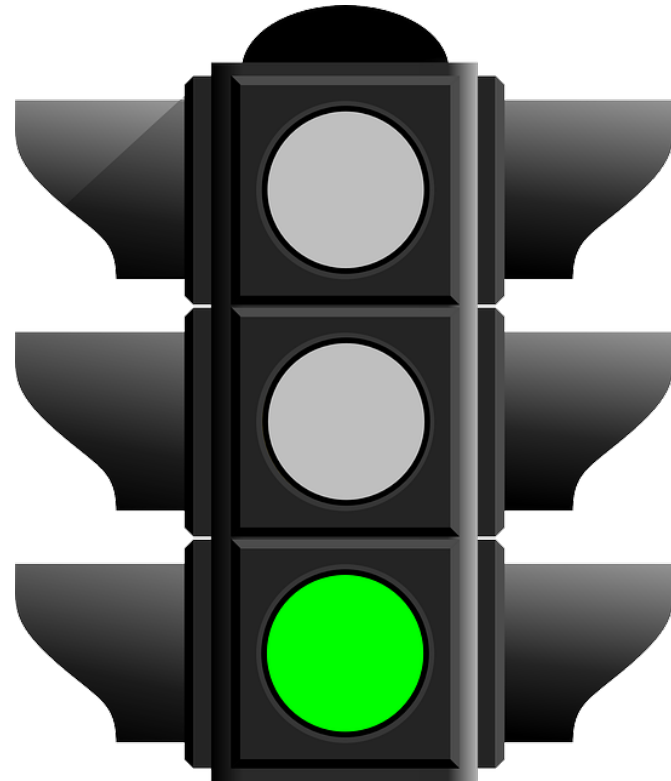
- Uses feedback to adjust operation.
- Example: Air conditioner (adjusts temperature based on sensor feedback).
- Advantages: More accurate, self-correcting, efficient.
- Disadvantages: More complex, higher cost.



# Design Task 1:

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- Determine the different parts of this control system (input, controller, process ect.) and whether it is open or closed loop:
- **Simple traffic light timer**
- Draw a diagram of the control system



# Design Task 2:

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- Determine the different parts of this control system (input, controller, process ect.) and whether it is open or closed loop:
- **Cruise control in vehicles**
- Draw a diagram of the control system



# Pairs Design Task:

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- Come to the front in pairs and get a design task from me
- You must determine the different parts of this control system (input, controller, process ect.) and whether it is open or closed loop
- You must then draw a diagram of the control system
- This must be all put onto a presentation and presented to the class

