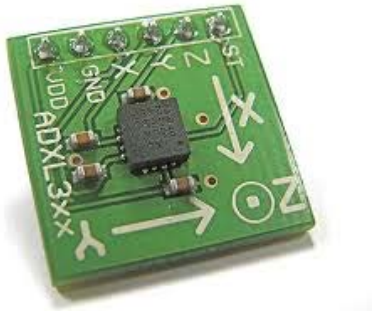
Sensors and Actuators

What are Sensors and Actuators?

- Electronic sensors and actuators are components that enable interaction between the physical world and electrical circuits.
- A sensor converts a physical phenomenon into an electrical signal for processing.
- An actuator converts a processed electrical signal to a physical phenomenon.

Sensors



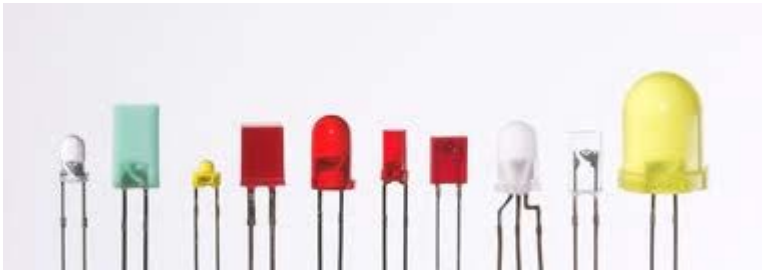





Sensors

- Are used to explore the (changes in) the environment.
- Provide direct information on physical parameters
  - light, pressure, temperature, magnetic field, etc.
- Provide indirect information on related parameters
  - human emotions, comfort, health.

Actuators



Actuators

- Convert processed electrical signal to a physical phenomenon.
- Controlled by continuous or discrete values
  - switch light on/off or use a dimmer
- Actuators are all around us:
  - speakers, electric motors, heating elements, light sources, etc.

Why Sensors and Actuators?

- Design products that act/react in context
- Extend the sensing beyond human senses
  - hearing range 20 Hz – 20 kHz
  - temperature range ??
  - visible light range

Central Heating System

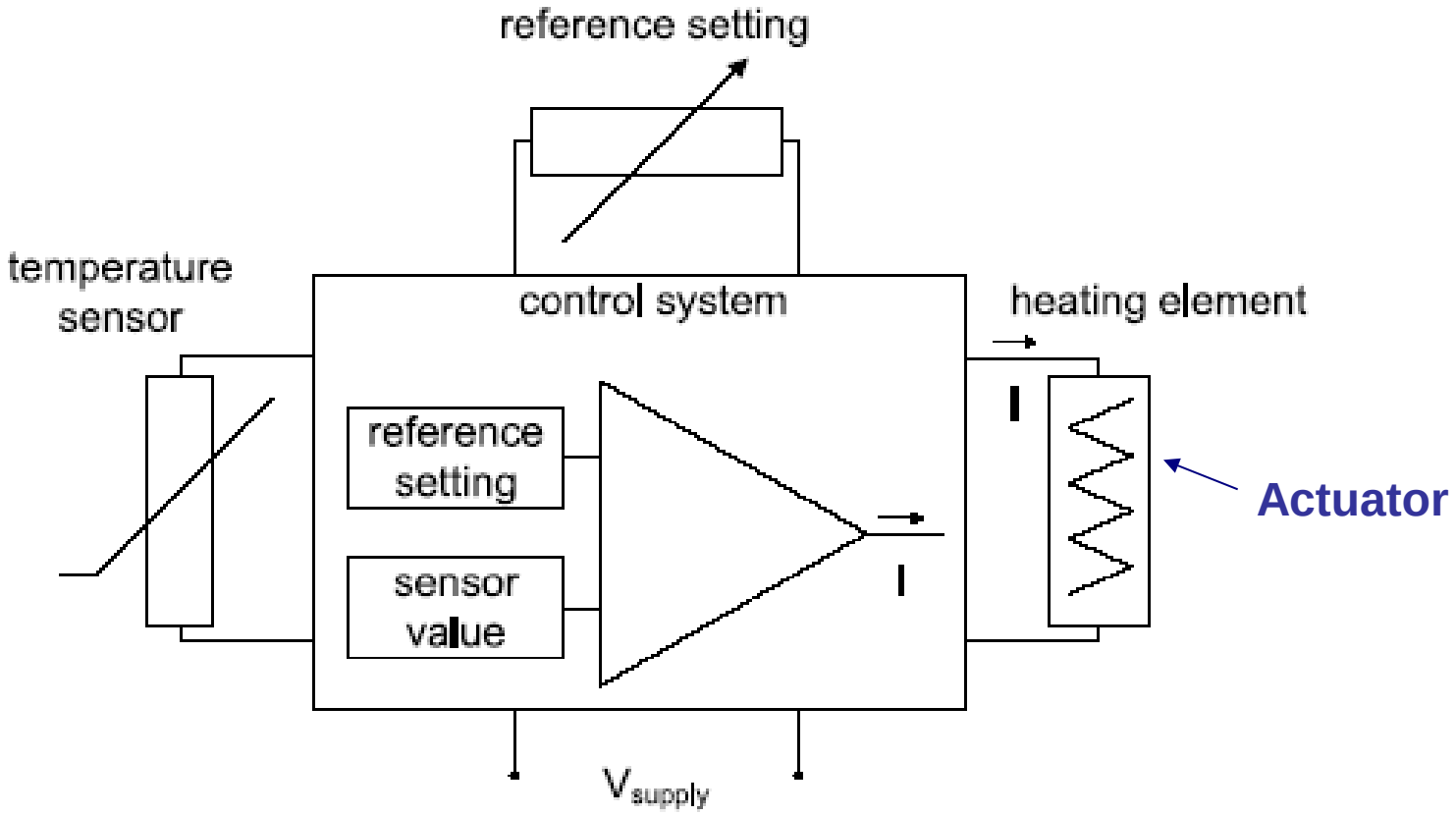


Figure 11.1: *Closed-loop temperature control system.*

Temperature - sensitive: NTC and PTC

- NTC: Resistance value decreases when temperature increases.
- PTC: Resistance value increases when temperature increases.

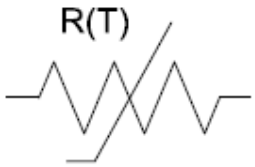


Figure 11.8: *Schematic symbol for NTCs and PTCs.*

Temperature - sensitive: NTC and PTC

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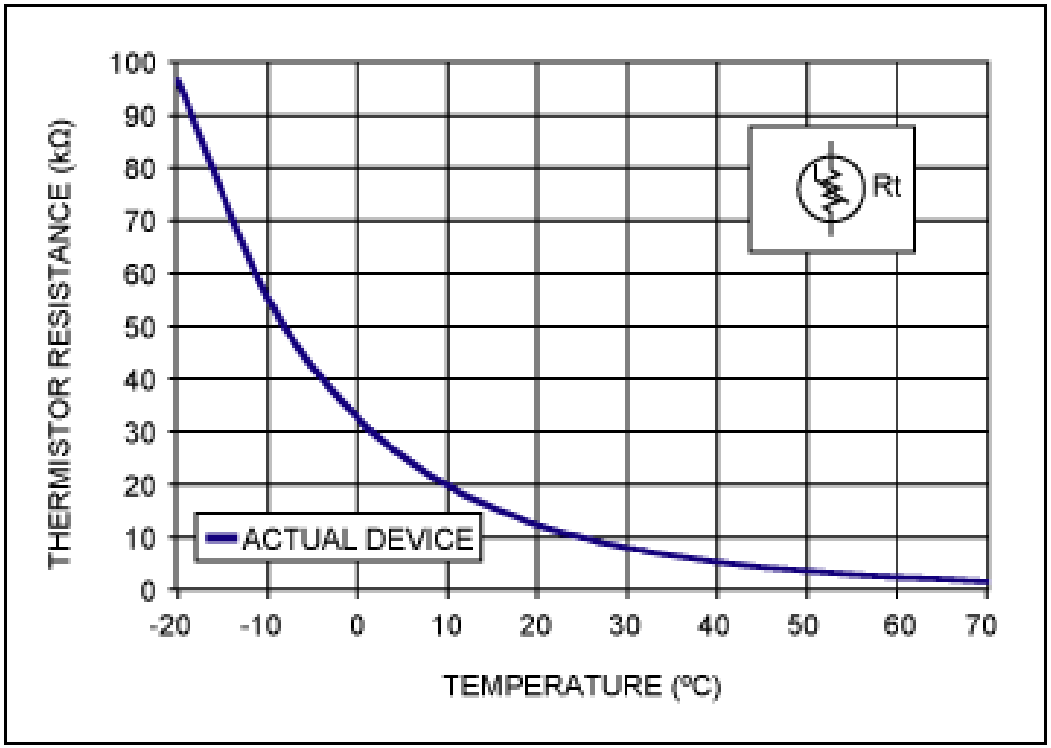
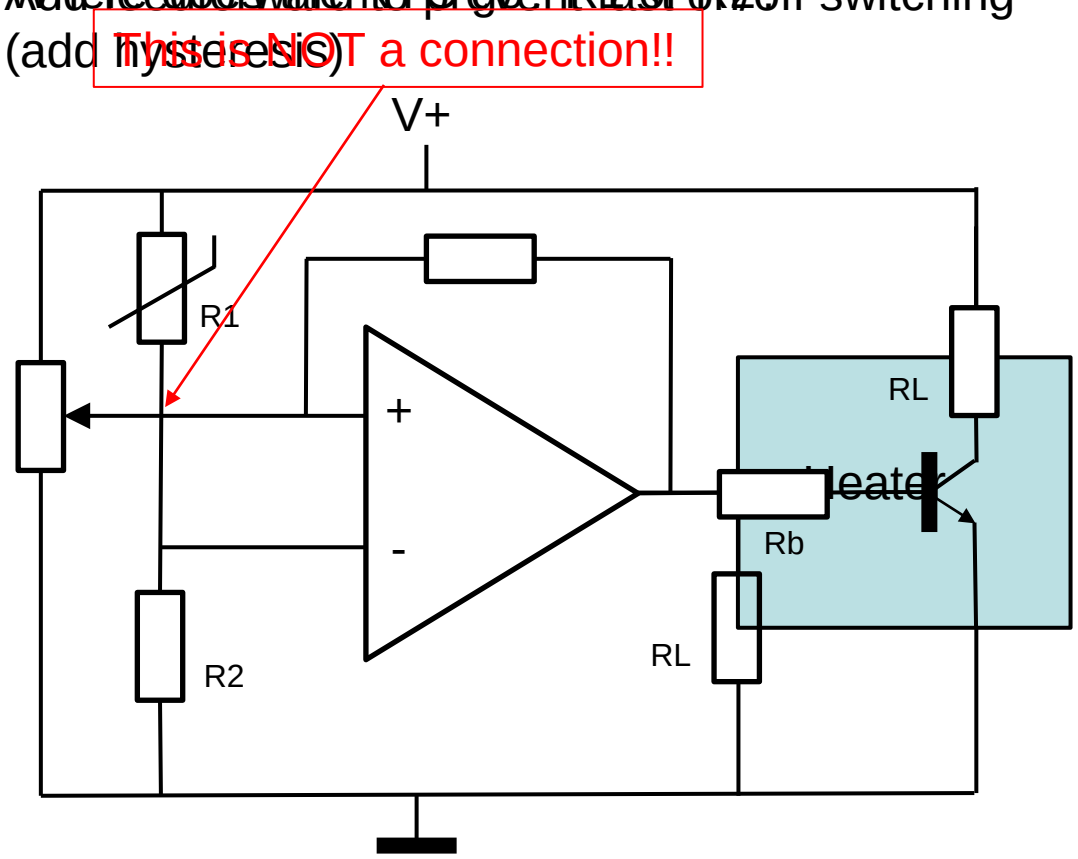


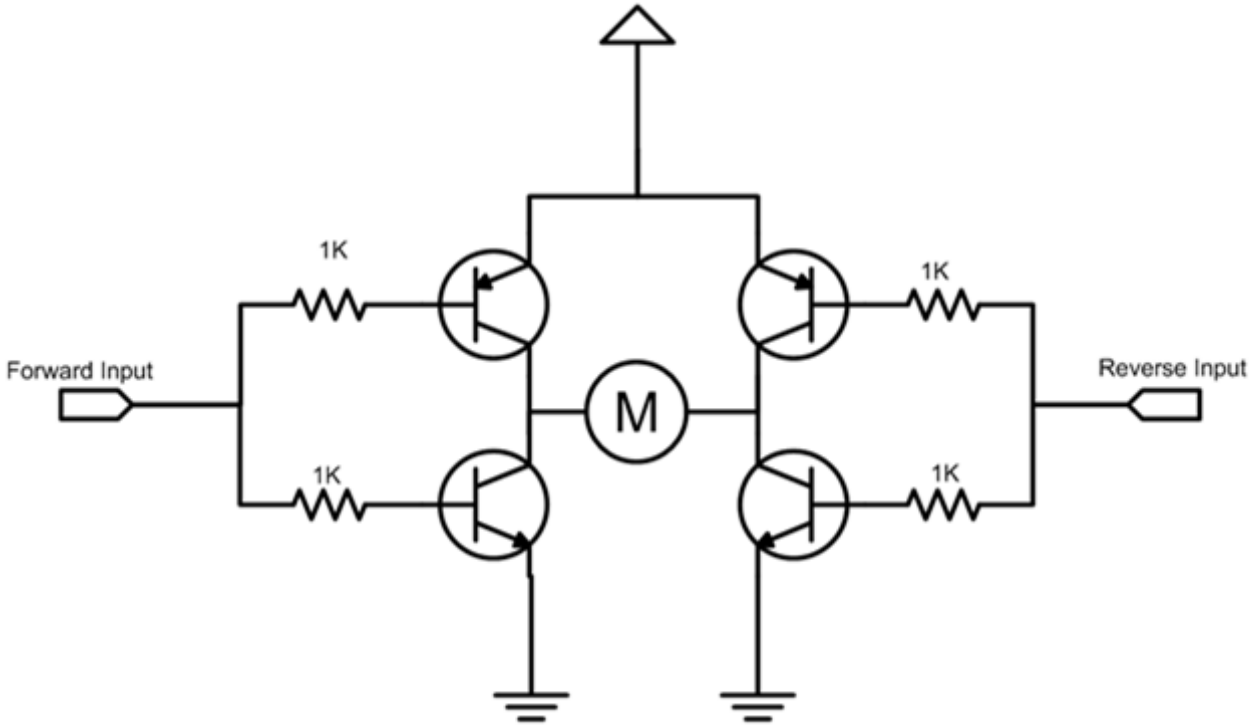
Resistance vs. temperature for NTC.

NTC and comparator

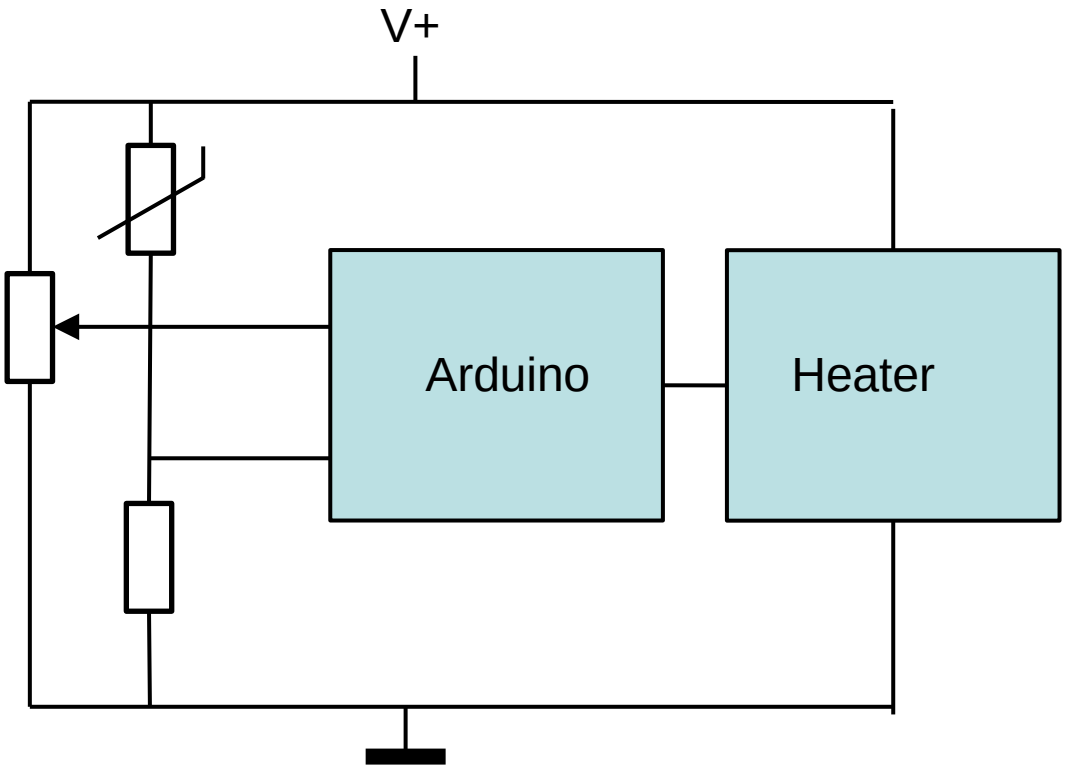
Add feedback to prevent fast on/off switching (add hysteresis)



H Bridge (for DC motor)



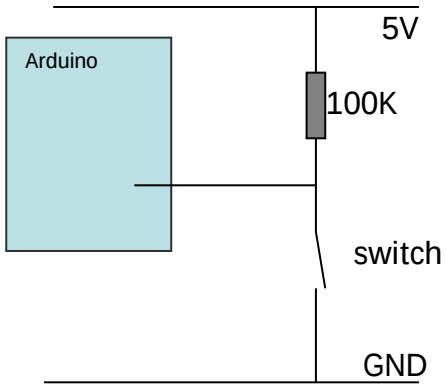
Arduino?

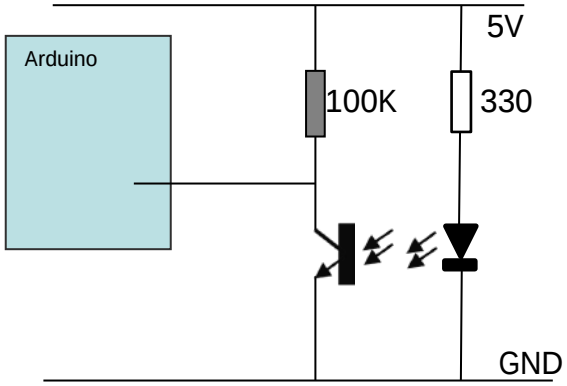


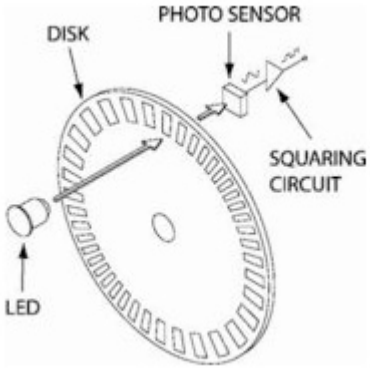
Arduino I/O

- Digital input: Low / High (0V / Vcc)
- Digital output: Low / High (0V / Vcc)
- Analog input: 0..Vcc (A/D conversion)
- Analog output: no… well, sort of…

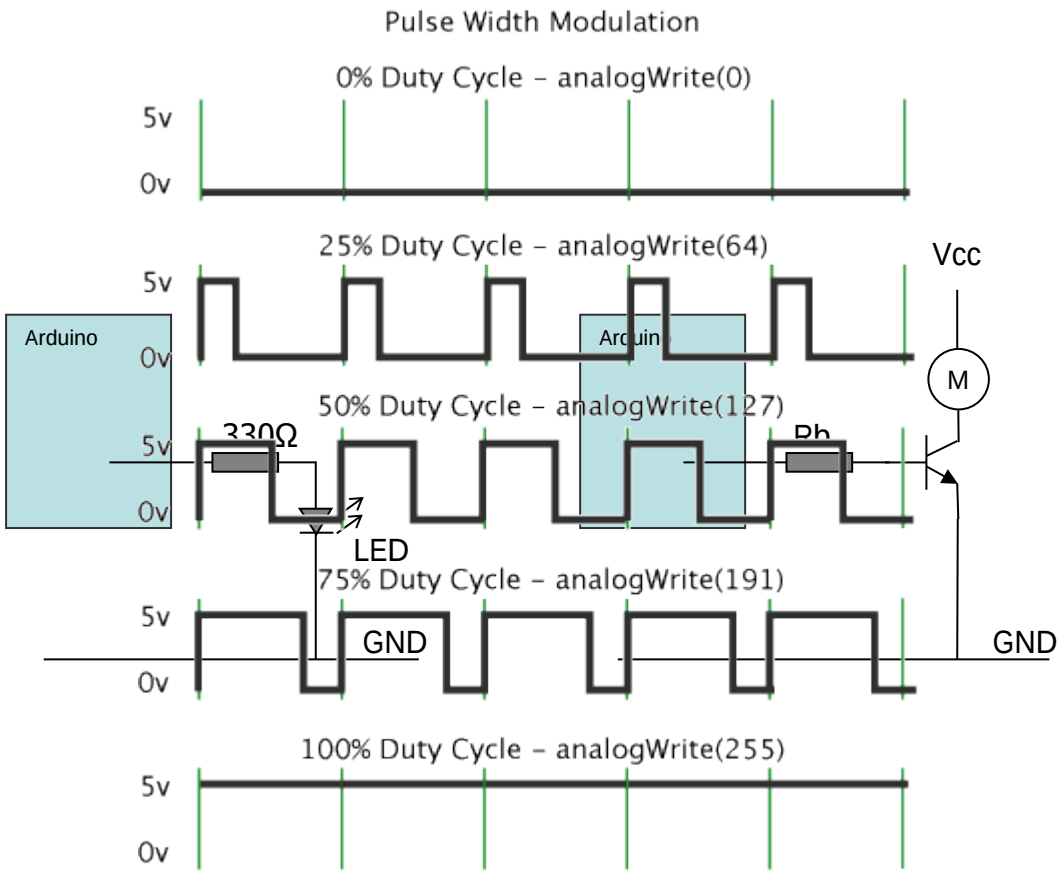
Digital input







Digital and analog output



Analog/Digital output