

SAKURA Science Workshop

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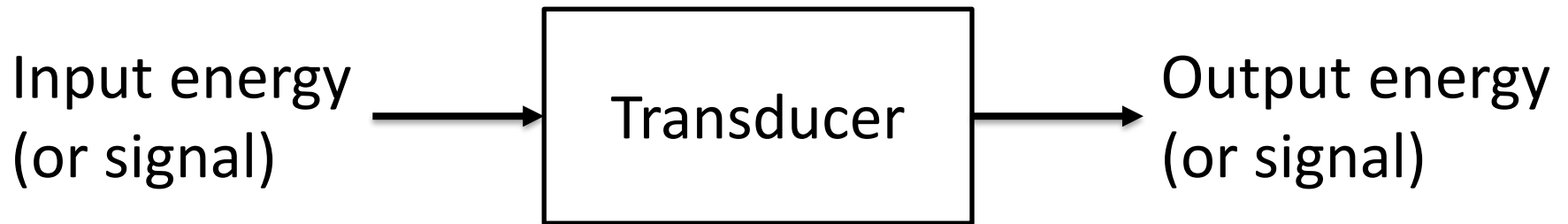
Kyushu Institute of Technology

Sensors

Sensors / Transducers

- Sensors are some kinds of transducers
- Transducer
 - ‘A device that transfers power from one system to another in the same or in different form’

Transducer



The forms of energy

Table 1.1 The main forms of energy

<i>Type of energy</i>	<i>Occurrence</i>
Radiant	radio waves, visible light, infra-red etc.
Gravitational	gravitational attraction
Mechanical	motion, displacement, forces etc.
Thermal	kinetic energy of atoms and molecules
Electrical	electric fields, currents etc.
Magnetic	magnetic fields
Molecular	binding energy in molecules
Atomic	forces between nucleus and electrons
Nuclear	binding energy between nuclei
Mass energy	energy given by $E = mc^2$

Question

- What is the input and output energy
 - Solar-cell
 - Thermocouple
 - Electromagnet
 - Nichrome wire

Types of energy:

Radiant

Mechanical

Thermal

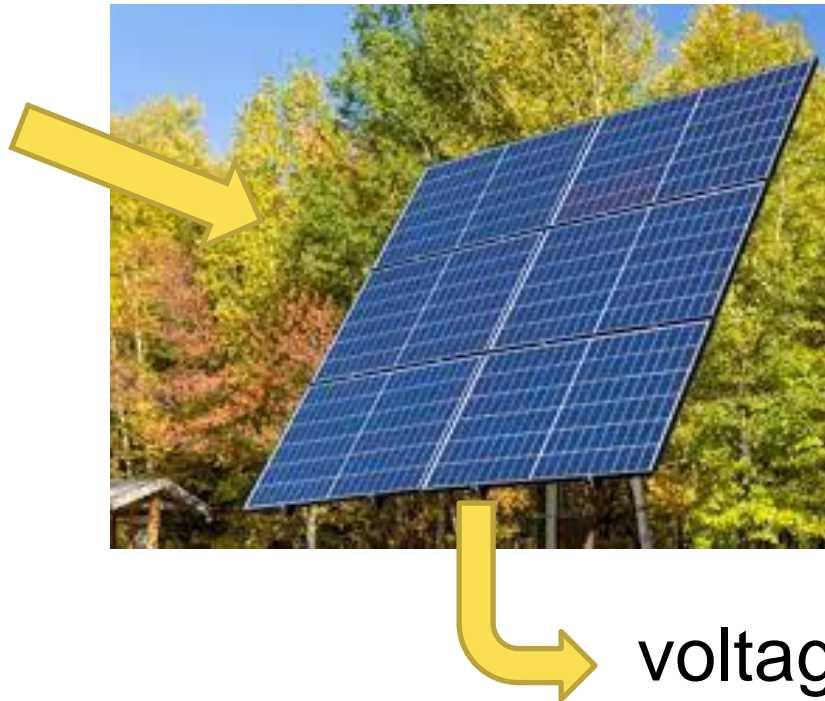
Electrical

Magnetic

Chemical

Solar cell

sunlight

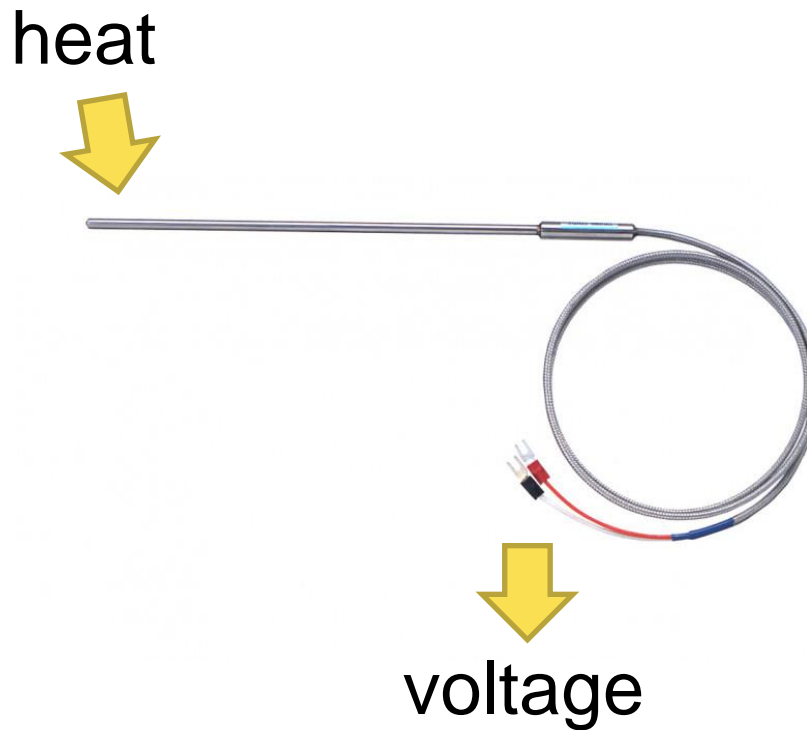


voltage

Types of energy:

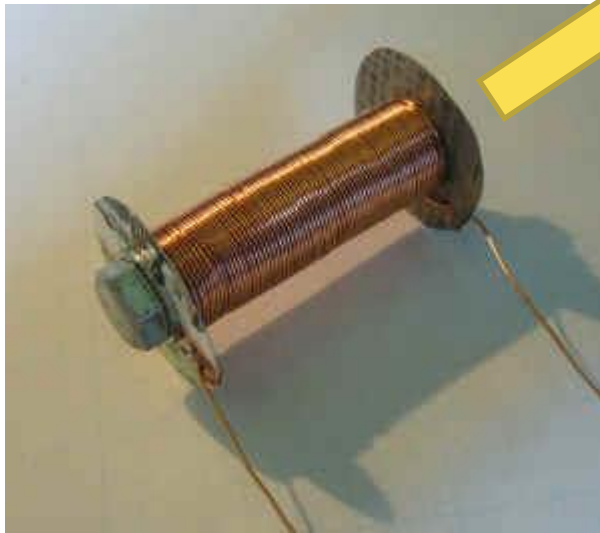
- Radiant
- Mechanical
- Thermal
- Electrical
- Magnetic
- Chemical

Thermocouple



Types of energy:
Radiant
Mechanical
Thermal
Electrical
Magnetic
Chemical

Electromagnet

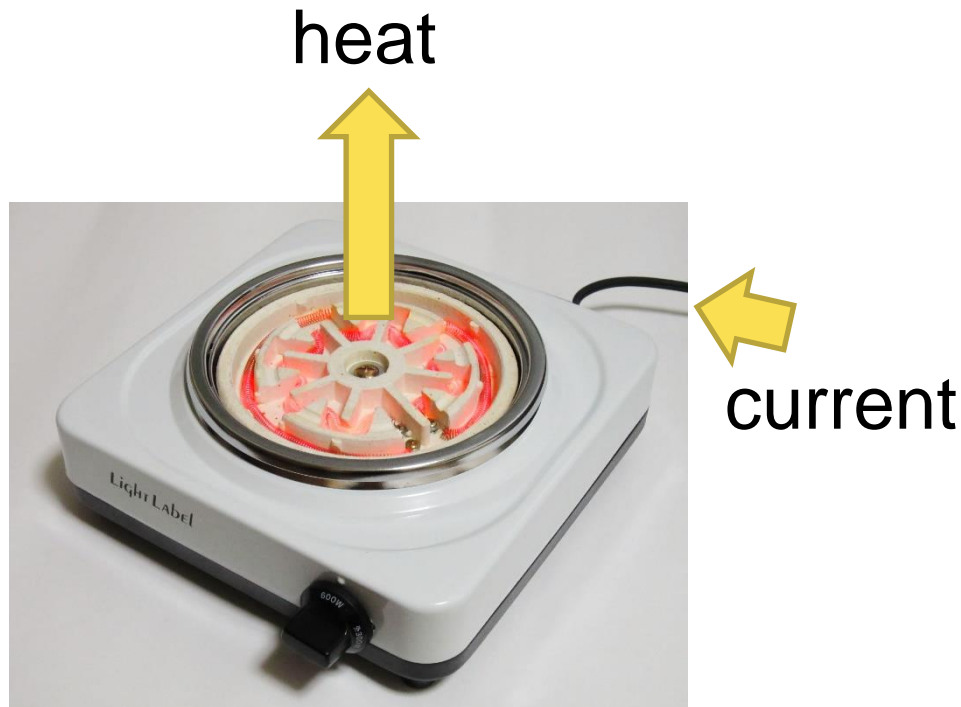


magnetic
field

current

Types of energy:
Radiant
Mechanical
Thermal
Electrical
Magnetic
Chemical

Nichrome wire



Types of energy:

- Radiant
- Mechanical
- Thermal
- Electrical
- Magnetic
- Chemical

Sensor

- Today we'll use "Light sensor".
- Measure brightness



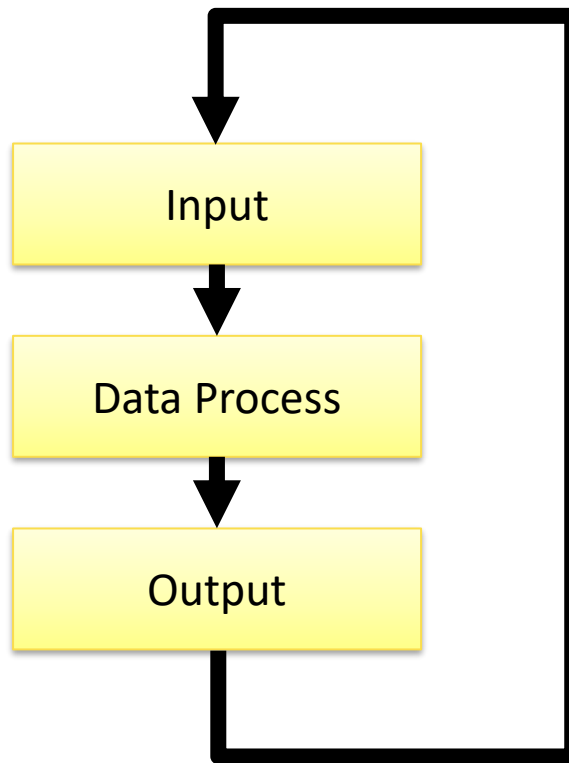
CdS Sensor

- Its **resistance value** changes by brightness.

Sensor system

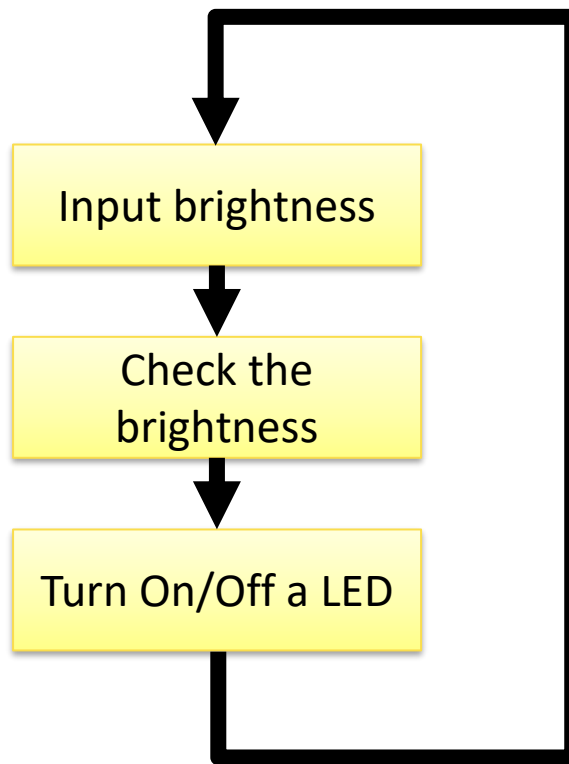
Software design

- Repeat forever



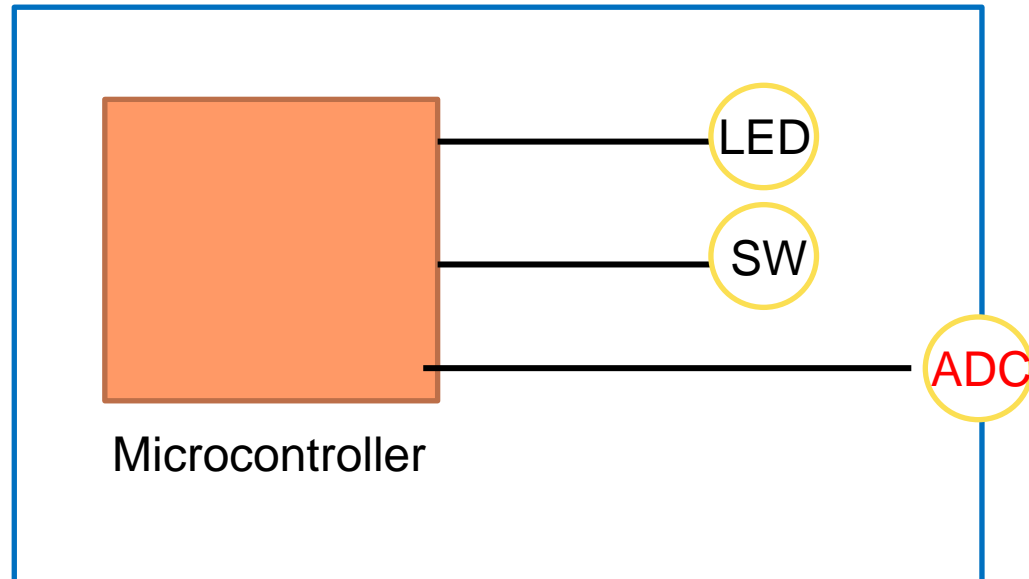
Brightness sensor

- Check the brightness



ADC

- ADC: Analog Digital Converter
 - Input = Voltage
- Microcontroller can measure **VOLTAGE**.



How to measure brightness?

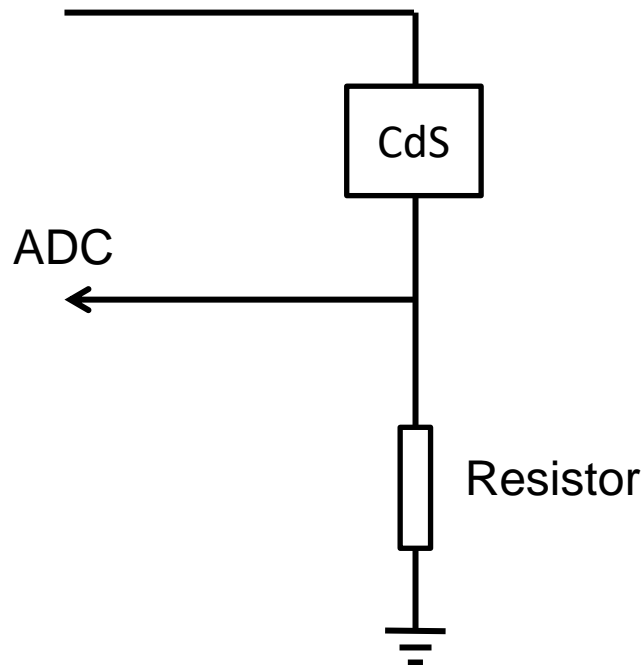
- CdS: its **resistance** value changes
- ADC: measure **voltage**

Resistance \neq Voltage

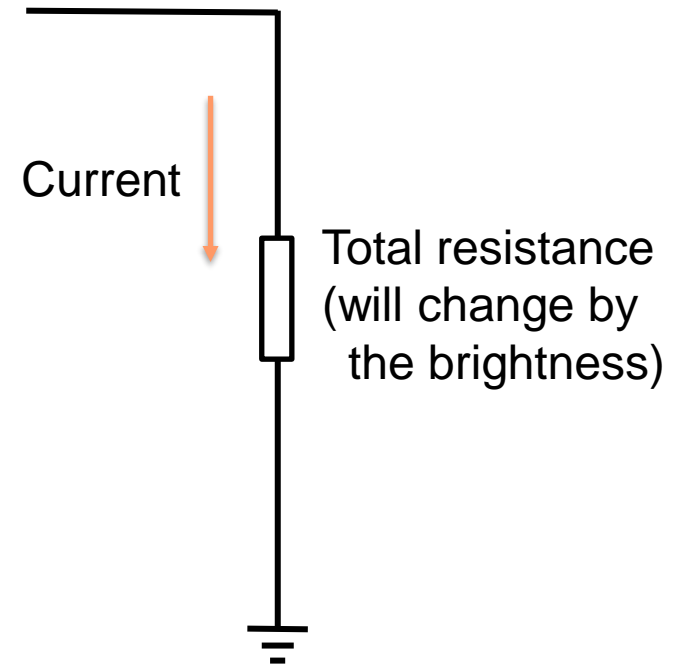
- Convert resistance value to current
by ohm's law
- Convert current to voltage
by ohm's law

Measurement circuit

Constant voltage



Constant voltage

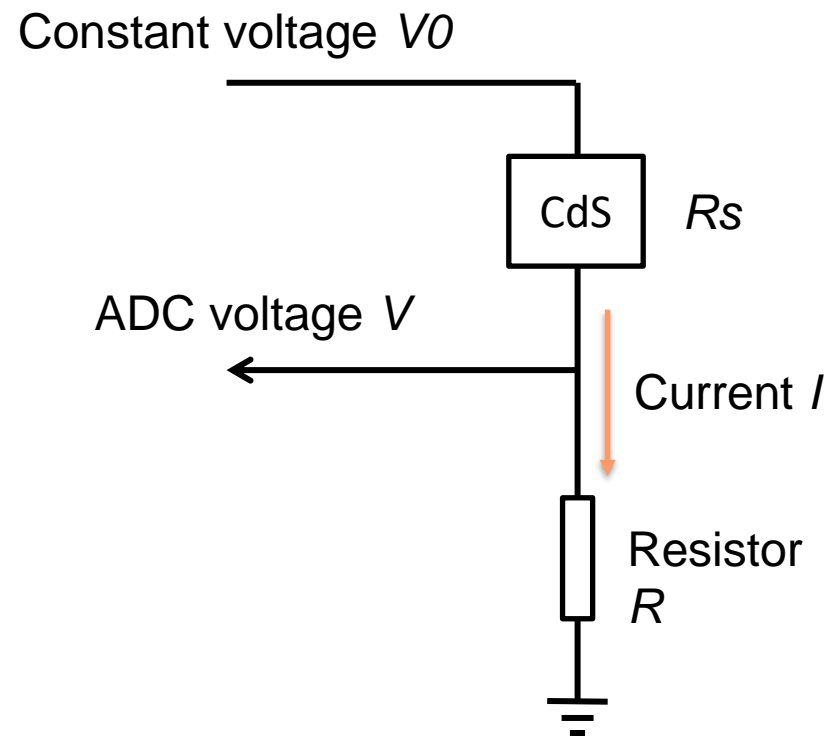


FYI, expression of this circuit

$$I = \frac{V_0}{R_s + R} \quad \leftarrow \text{Total resistance}$$

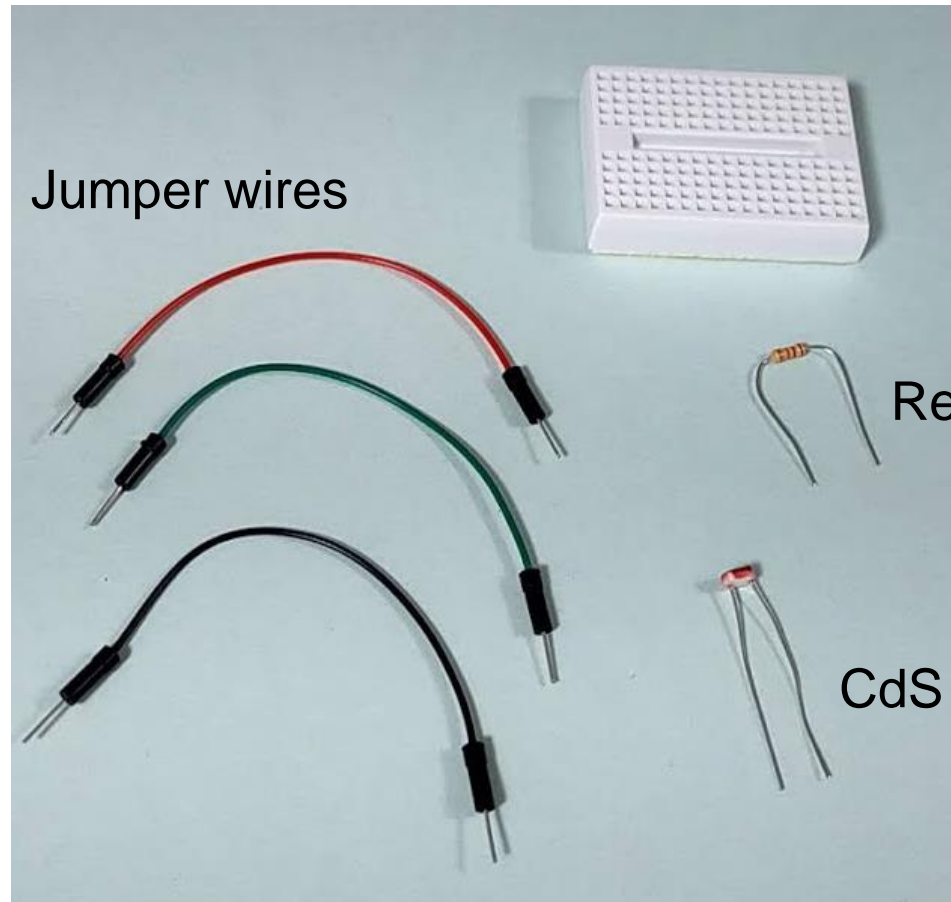
$$V = I R = \frac{R}{R_s + R} V_0$$

V changes by R_s changing.

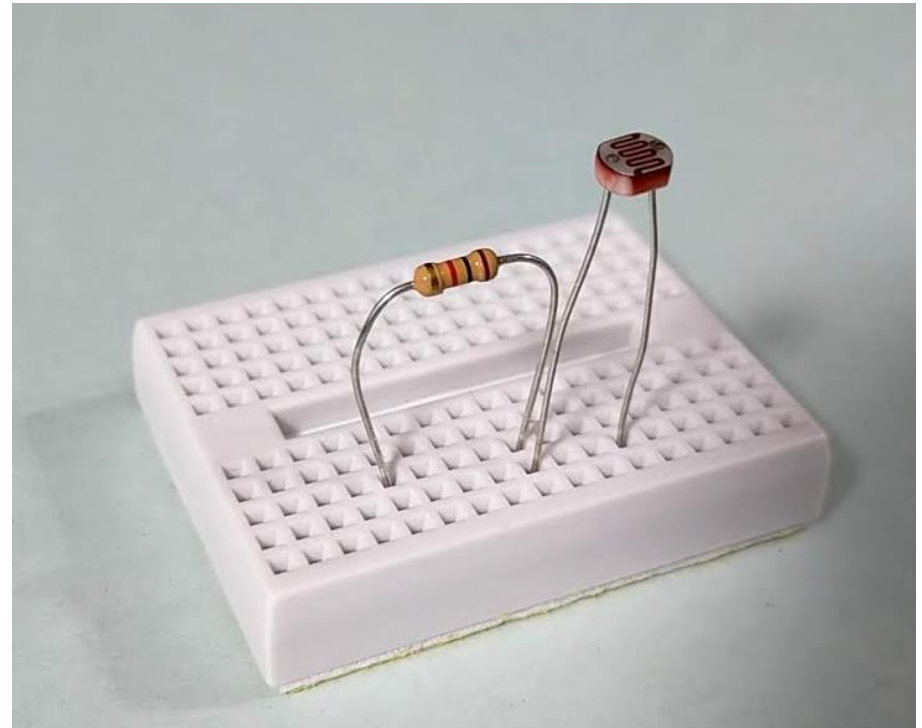
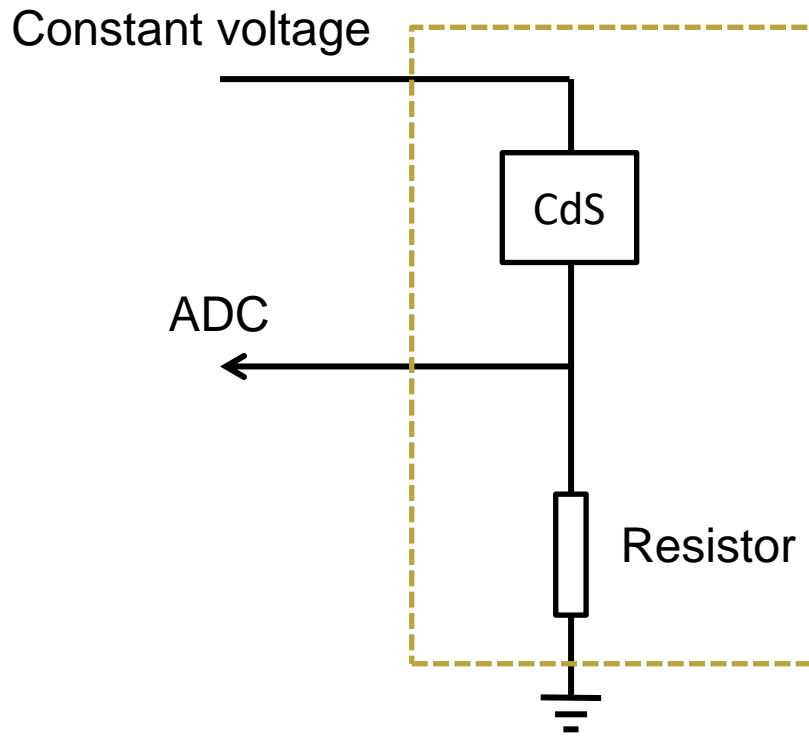


Hardware

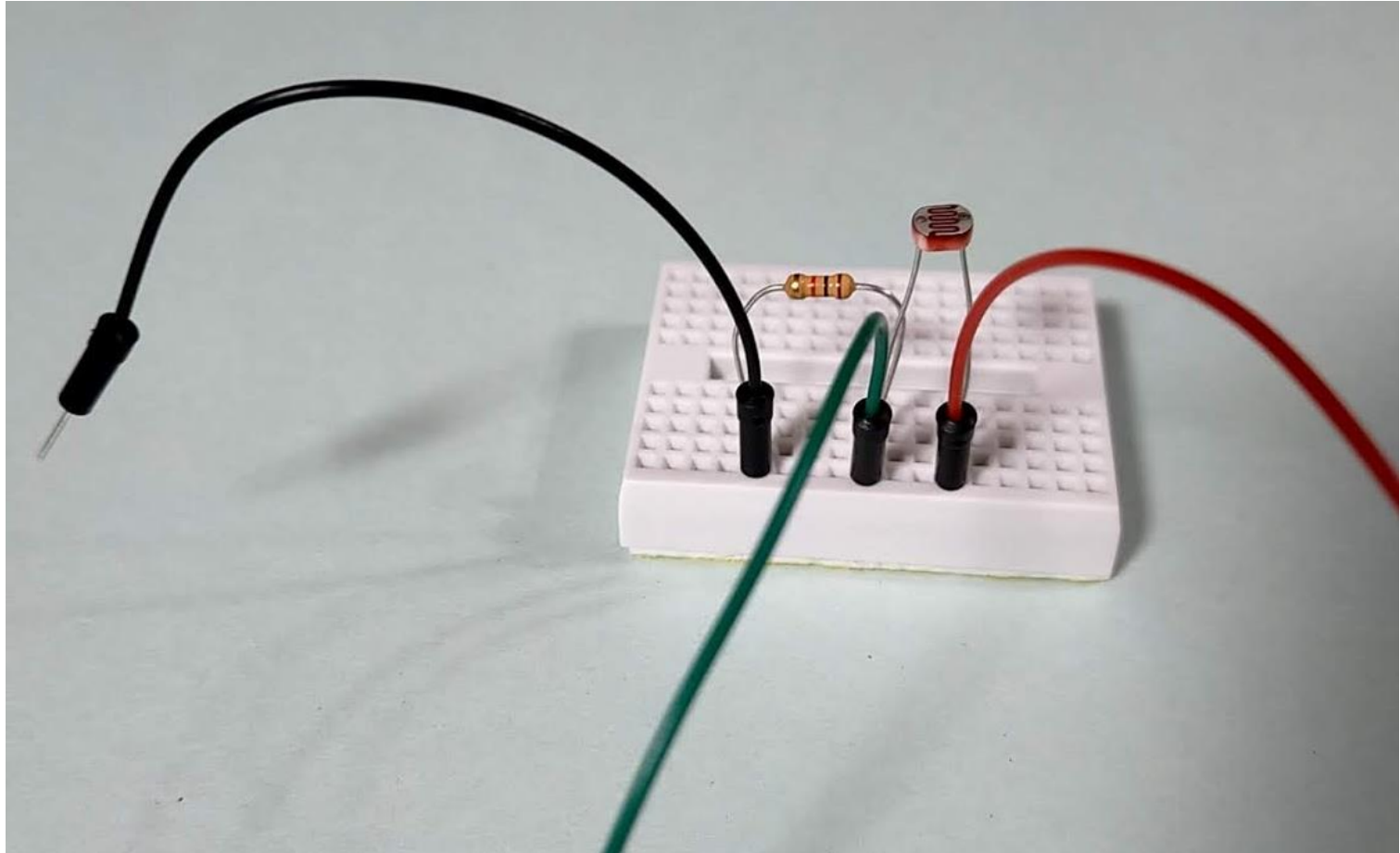
Items



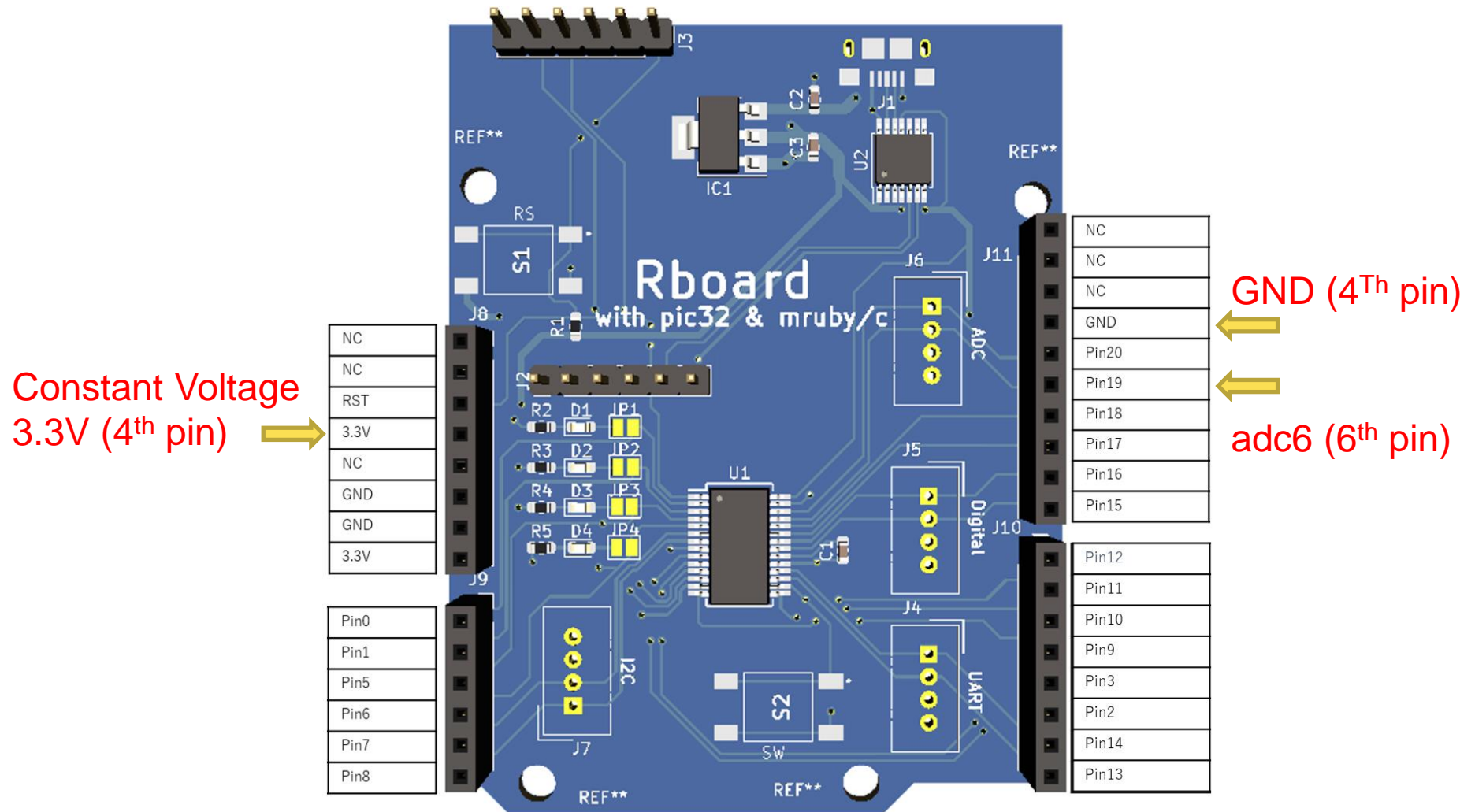
- Implement this circuit on bread board



Jumper wires



Connect wires to Rboard



Software

CdSPogram1

(CdSPogram1)





```
pinMode(0,0)
adc = ADC.new()
adc.ch(6)
while true
  adc.start
  voltage = adc.read_v
  adc.stop

  if voltage > 1.0 then
    digitalWrite 0, 1
  else
    digitalWrite 0, 0
  end
  sleep 0.1
end
```

Exercises

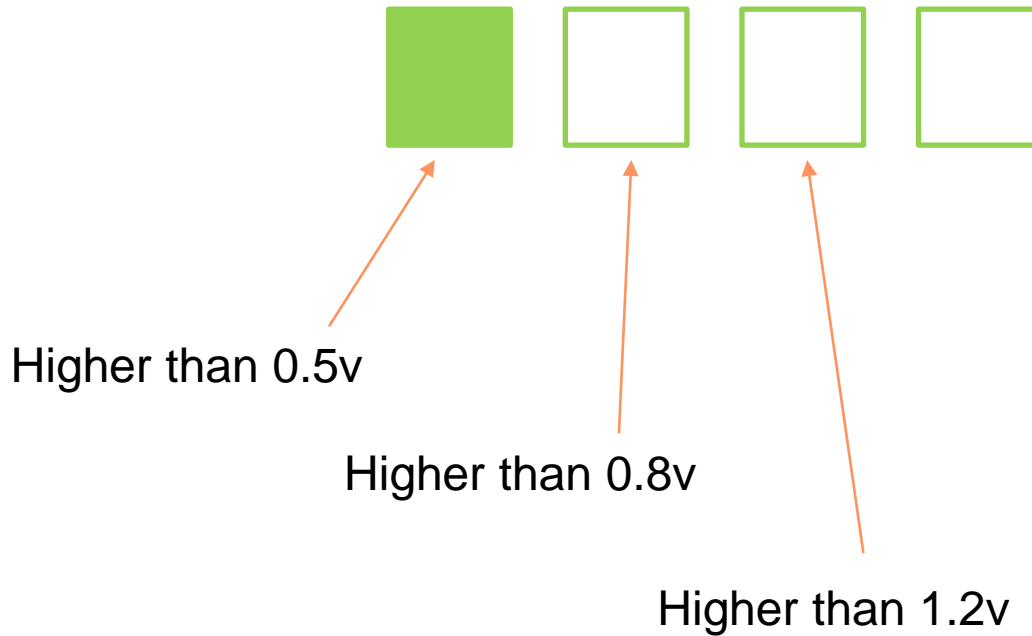
Exercise 2

- Brightness Level meter

- Dark: 0 LED 
- Little dark: 1 LED 
- Bright: 2 LED 
- Brighter: 3 LEDs 

ADC voltage will change from 0.1v to 1.7v

Hint



Conclusion

IoT Programming

- IoT programming basics.
- More details,
 - Sensor
 - Hardware
 - Mathematics
 - Physics
 - and Programming