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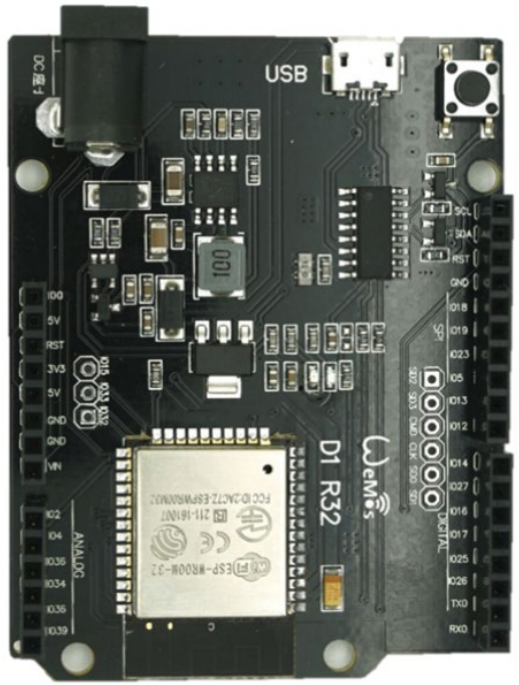
ELSE PRO
WEBINAR 3 – PART 1
Using sensors and actuators for practical experiments

José V. Benlloch-Dualde



Wemos D1 R32 (based on ESP32)

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jbenlloc@disca.upv.es

How to relate electronics to the physical world?

1. Measuring the appropriate variables (**SENSORS**)
2. Responding to those values (Actuators)

Microcontroller (*Arduino board or similar*) + Programming

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Garden

https://esgarden.webs.upv.es/iot.html

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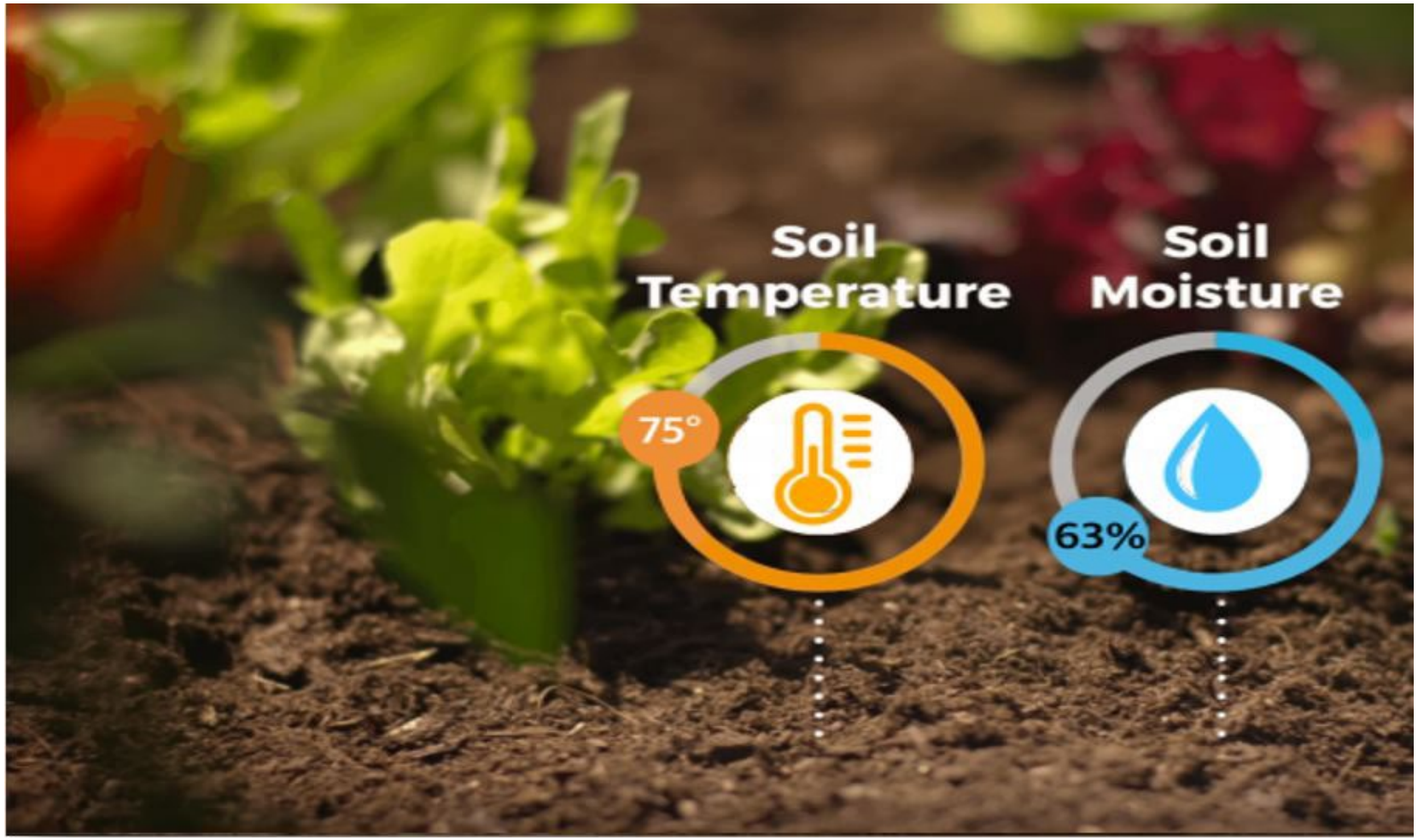
IoT Garden



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An example about the use of electronics within Sensors and Actuators

The LDR

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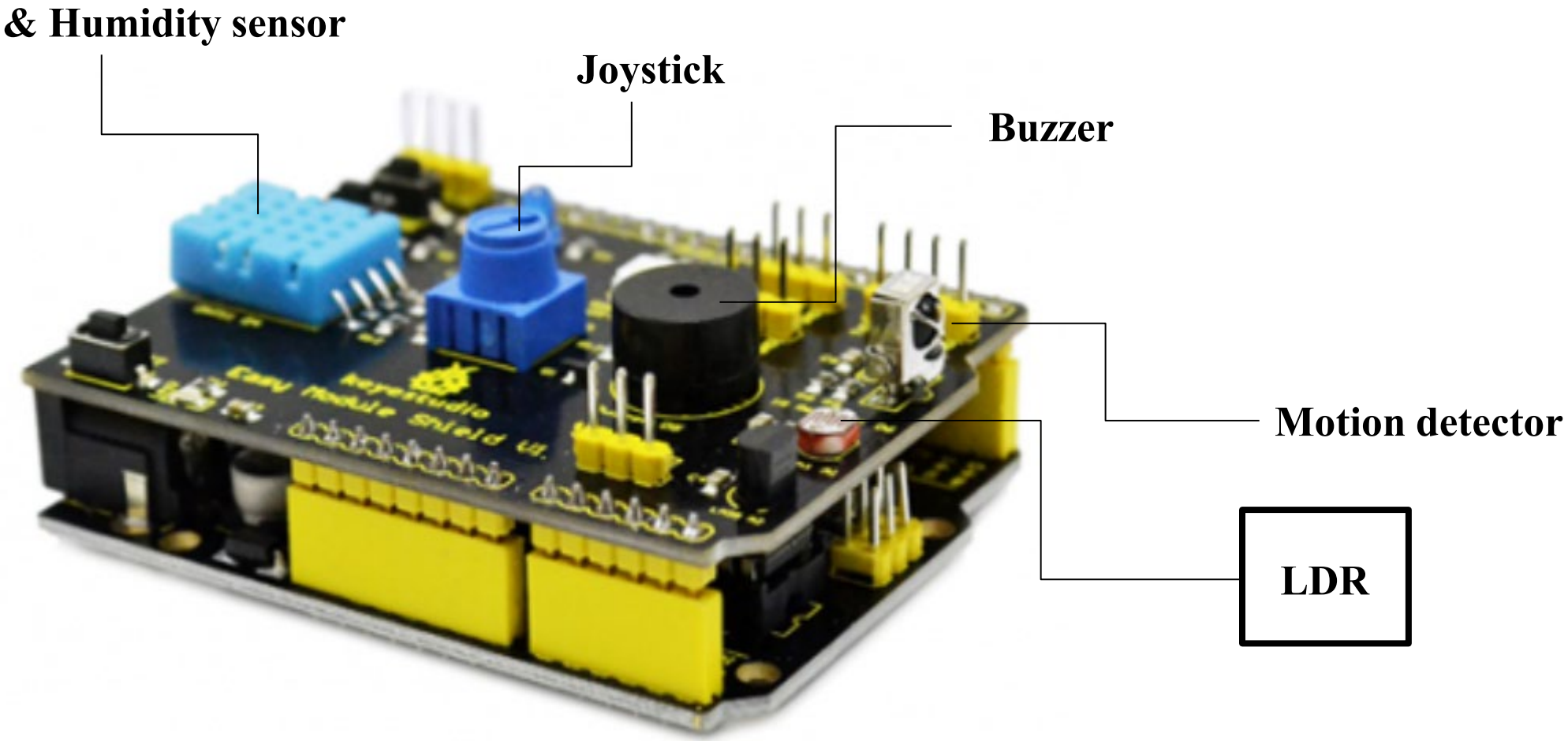
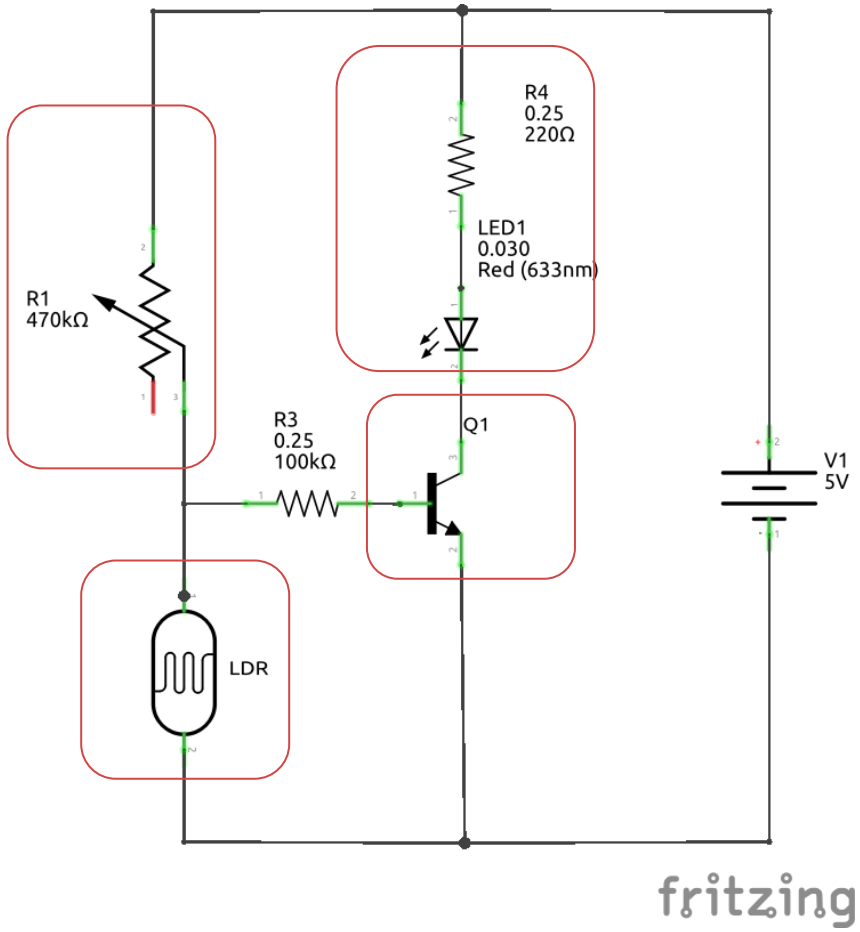
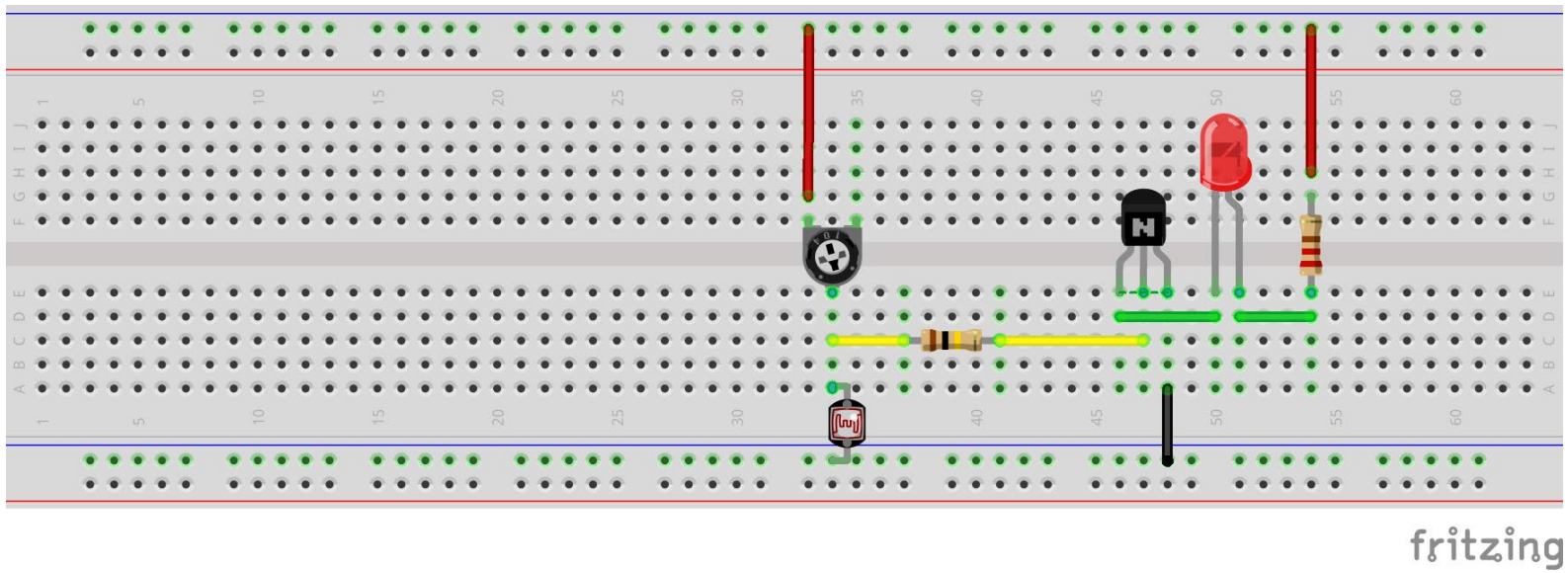
Sensor & Actuators



1a. To design a circuit that turns on an LED when it becomes dark (BJT)





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Light Dependent Resistor (LDR)

- ✓Resistance increases with decreasing light levels.
- ✓A device with sensitivity in the visible light region, such as the NSL-19M51
  - ➢In dark conditions, the resistance is high (up to a few MΩ)
  - ➢The resistance falls to less than 1kΩ in high light levels.

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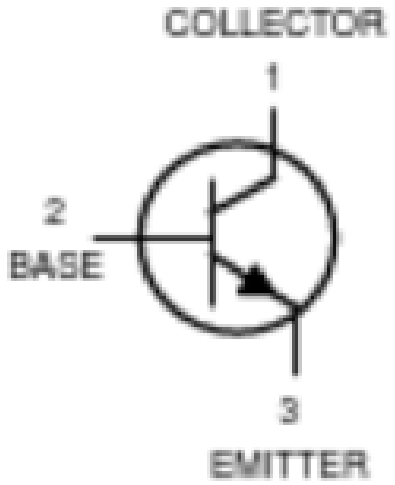
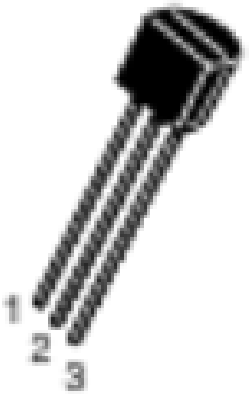
Bipolar Junction Transistor (BJT)

If the base-emitter junction is forward-biased

$I_B > 0$ and $I_C > 0$

In the active region $I_C = \beta * I_B$





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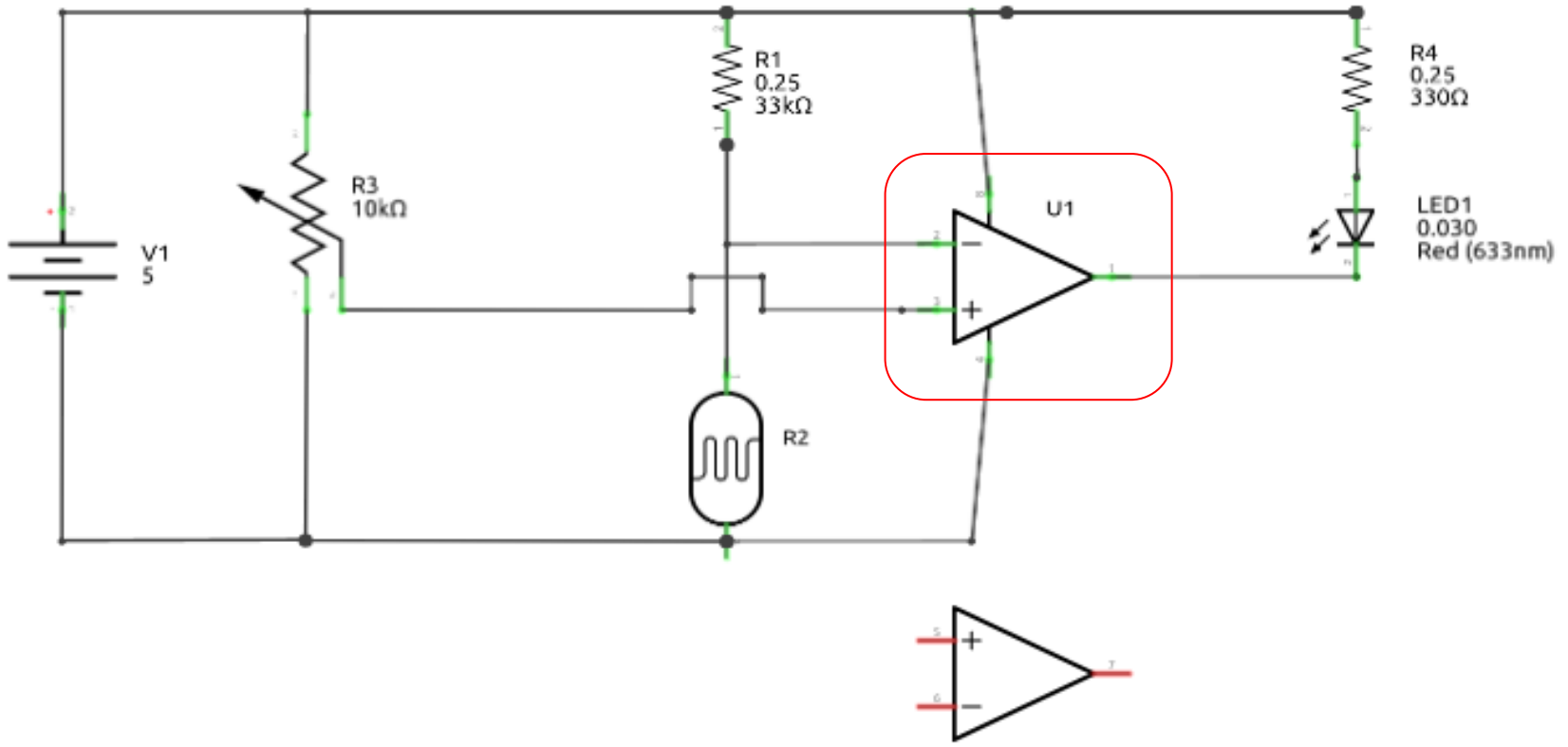
1b. To design a circuit that turns on an LED when it becomes dark (comparator)



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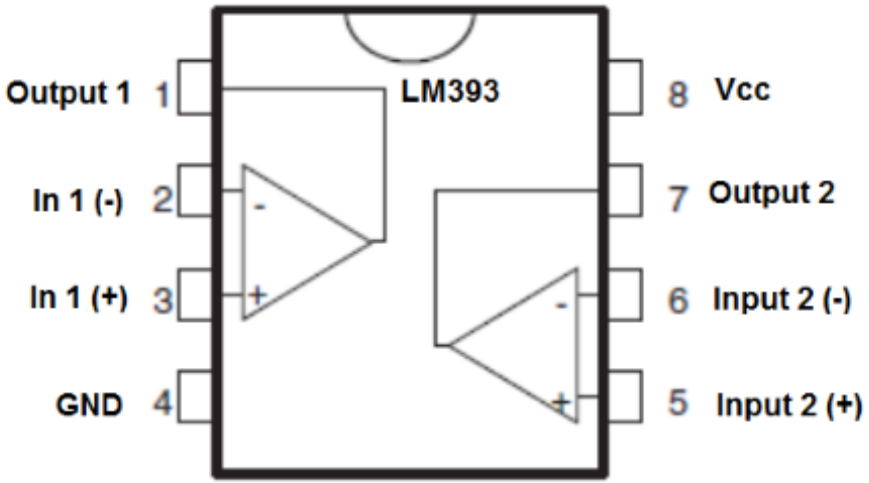
Comparator

- ✓The **LM393 IC** consists of two independent voltage comparators, each including two inputs (IN+, IN-) and one output (OUT).
  - ✓If $V_{IN+} > V_{IN-}$ ---> $V_{OUT} = V_{CC}$
  - ✓If $V_{IN+} < V_{IN-}$ ---> $V_{OUT} = 0$



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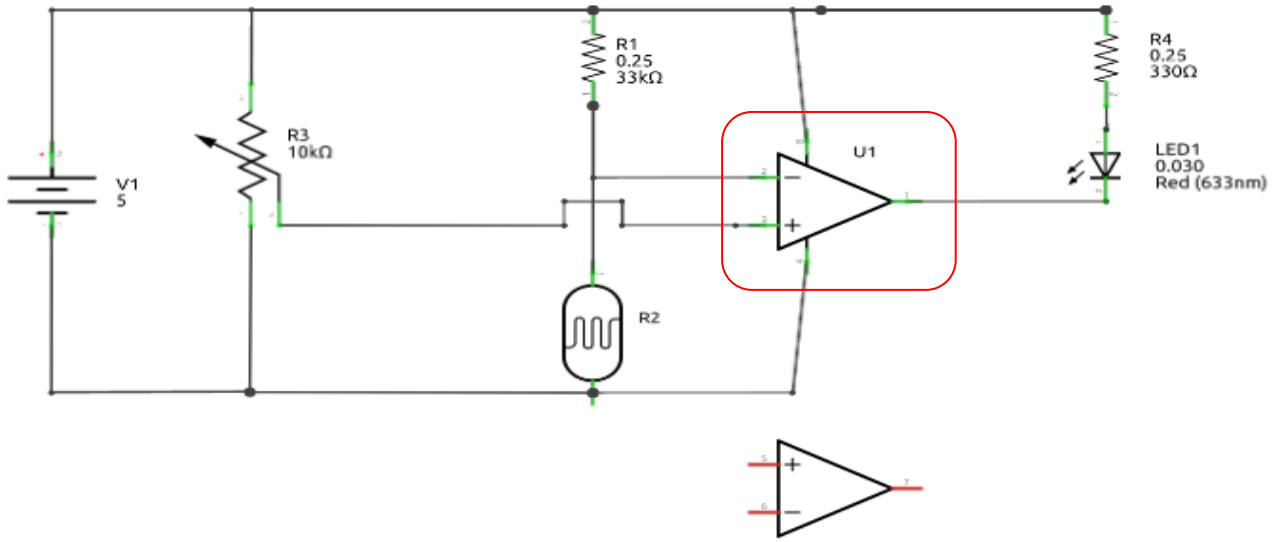
1b. Comparator

- ✓ The 33kΩ resistor and the LDR make up a voltage divider.
- ✓ Again, depending on the light level conditions, we first have to set the reference voltage (V+) through the 10K potentiometer in such a way that:

$V+ > V-$ ($V_{OUT} = V_{CC}$)

$V+ < V-$ ($V_{OUT} = 0$ → LED ON)



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THANK YOU

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