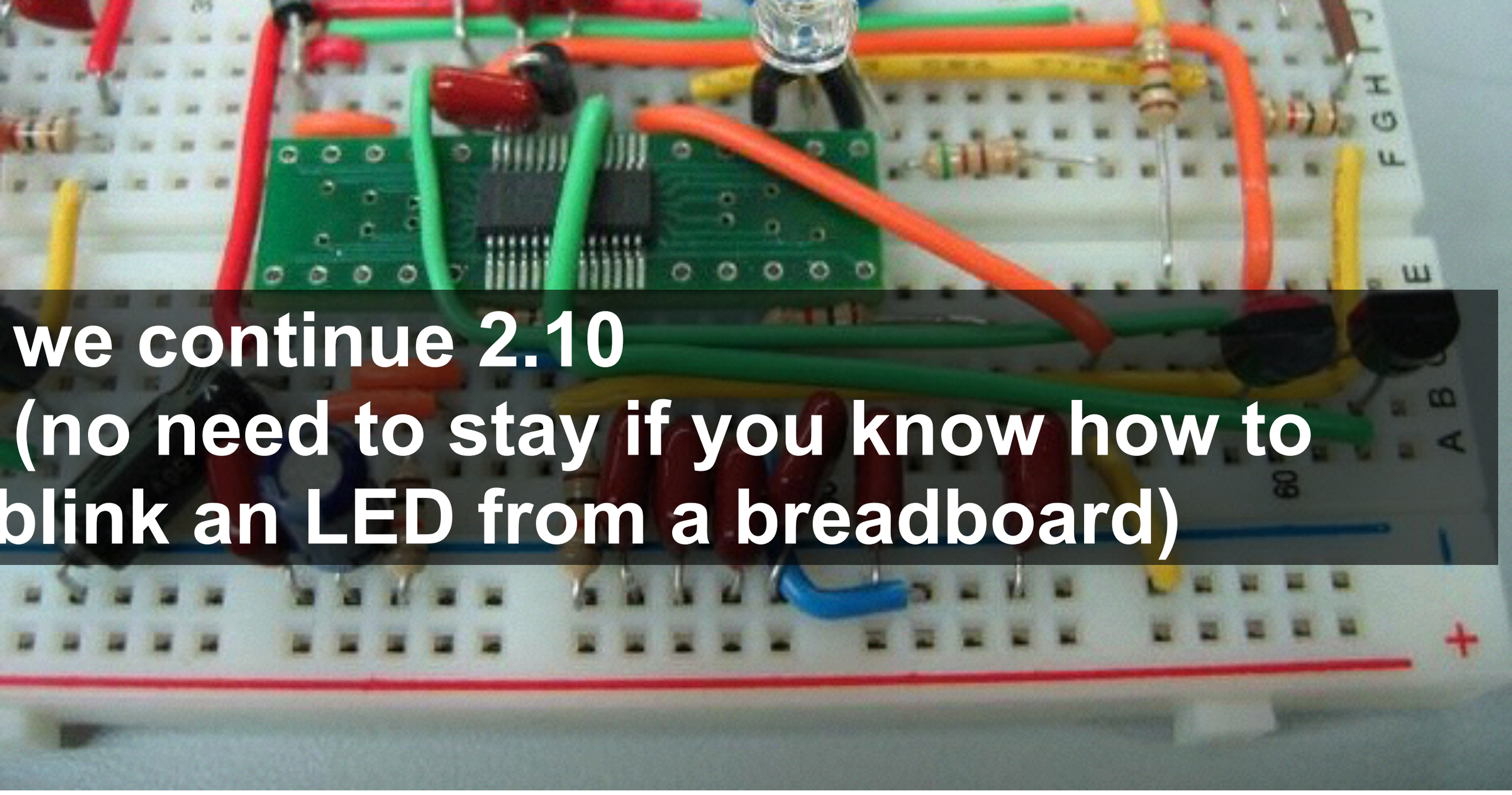


we continue 2.10
(no need to stay if you know how to
blink an LED from a breadboard)

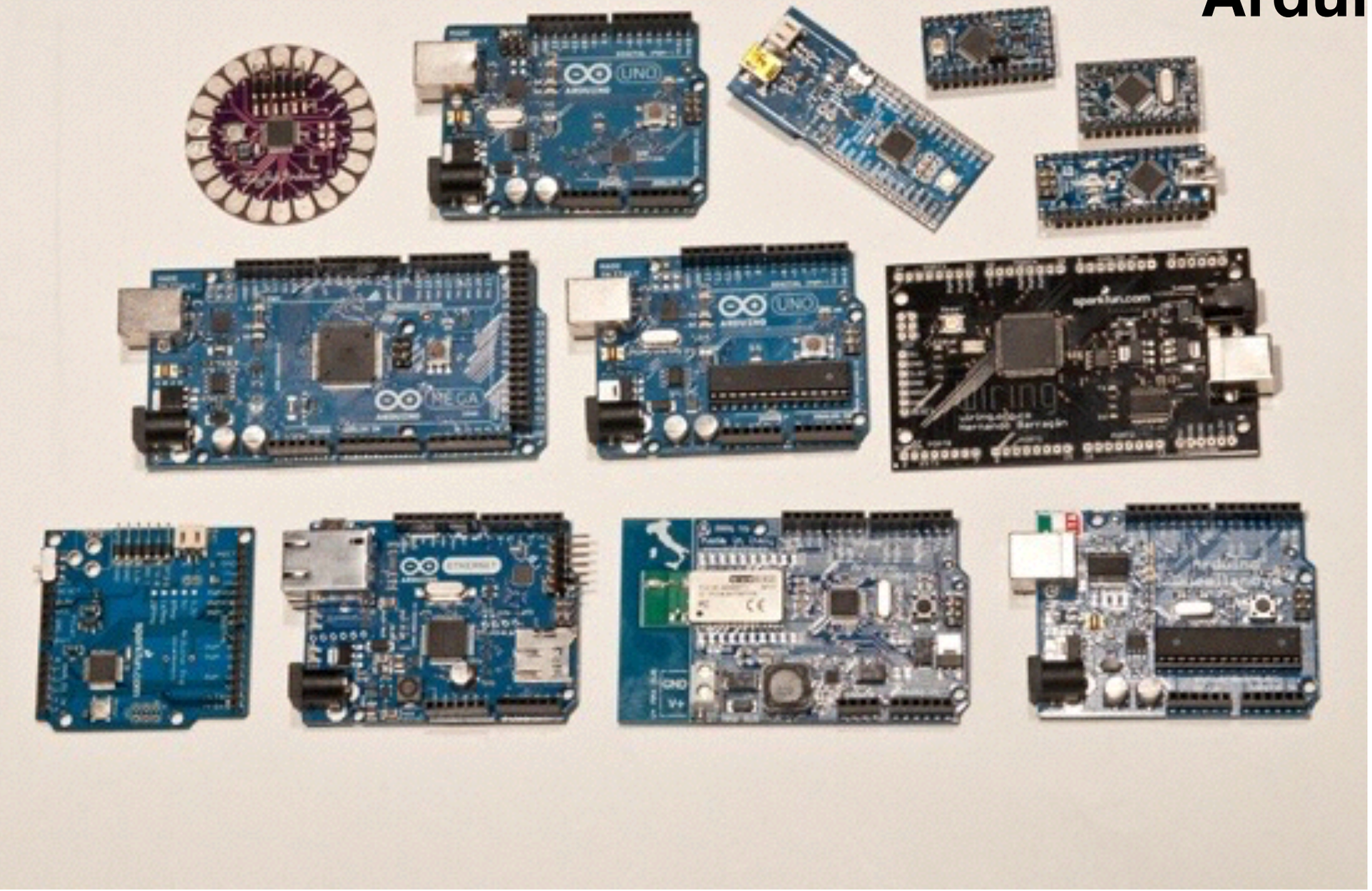
Intro to Electronics

6.S063 Engineering Interaction Technologies

Prof. Stefanie Mueller | MIT CSAIL | HCI Engineering Group

the micro-controller

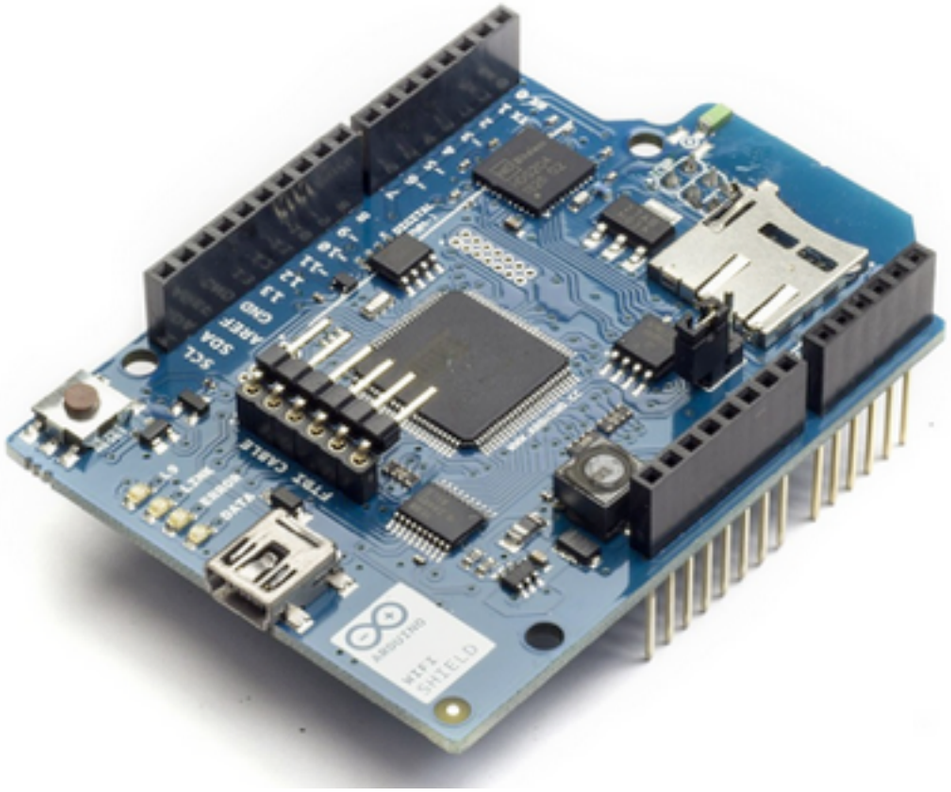
Arduino



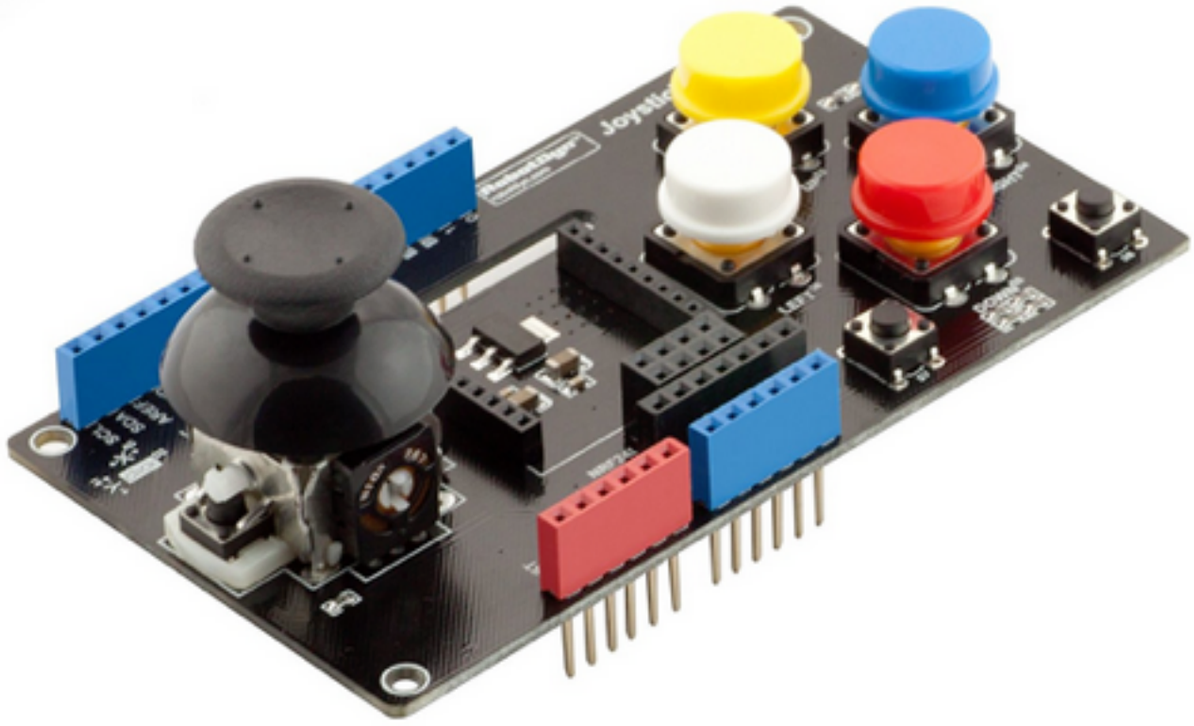
many different ones.
what are some **differences** between them?

<30s brainstorming>

add more **functionality:**



wifi shield

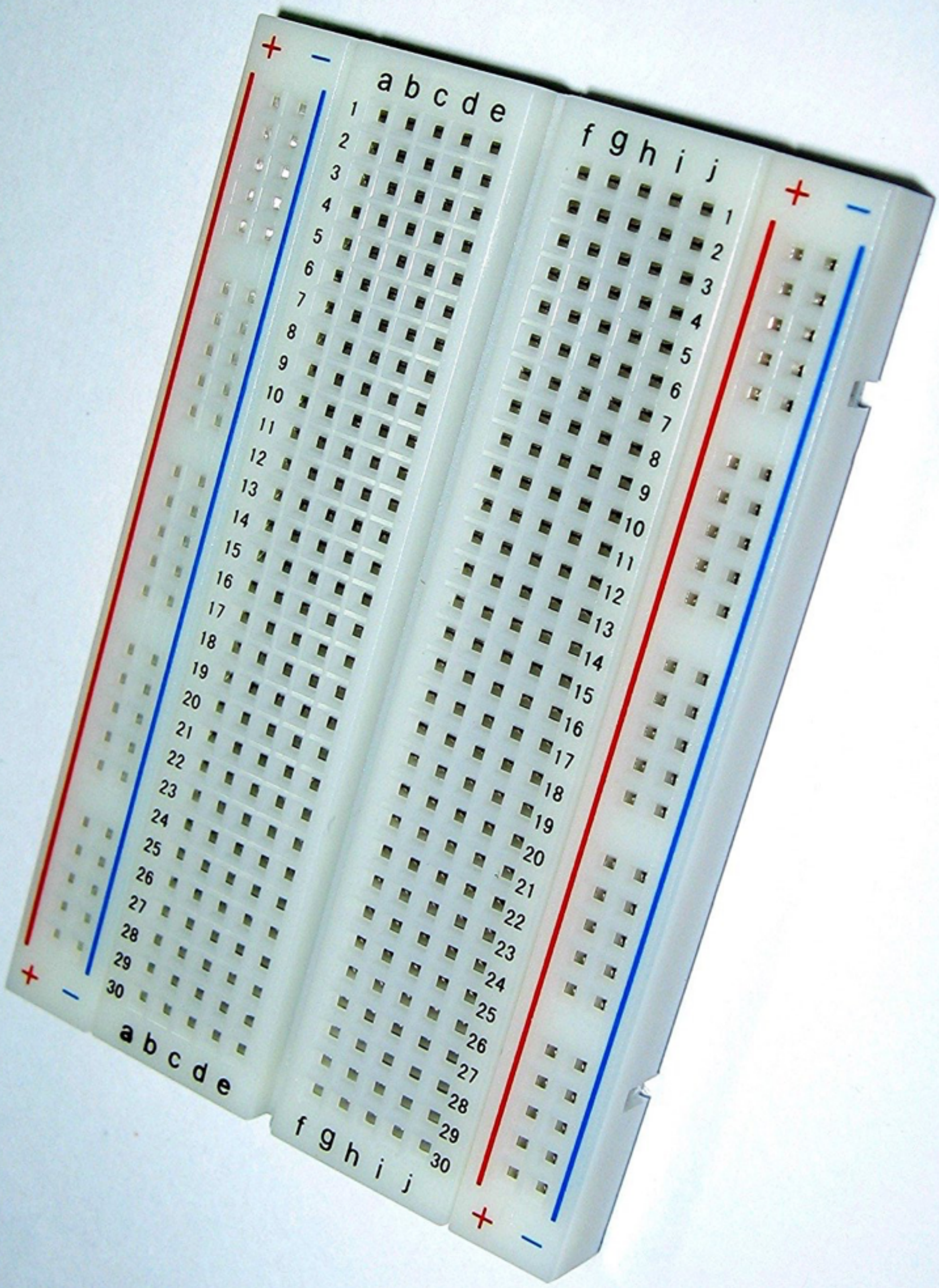


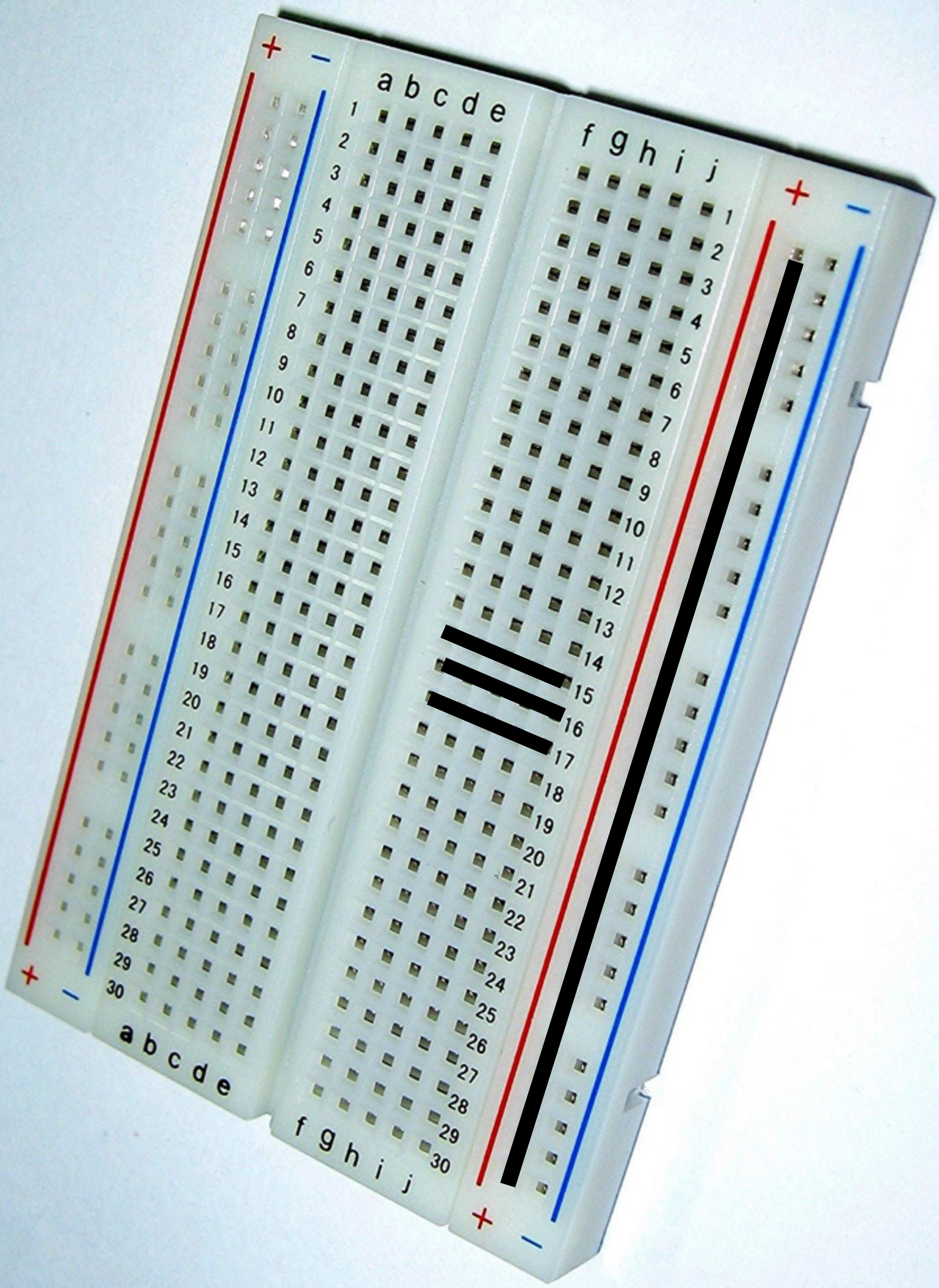
game controller shield

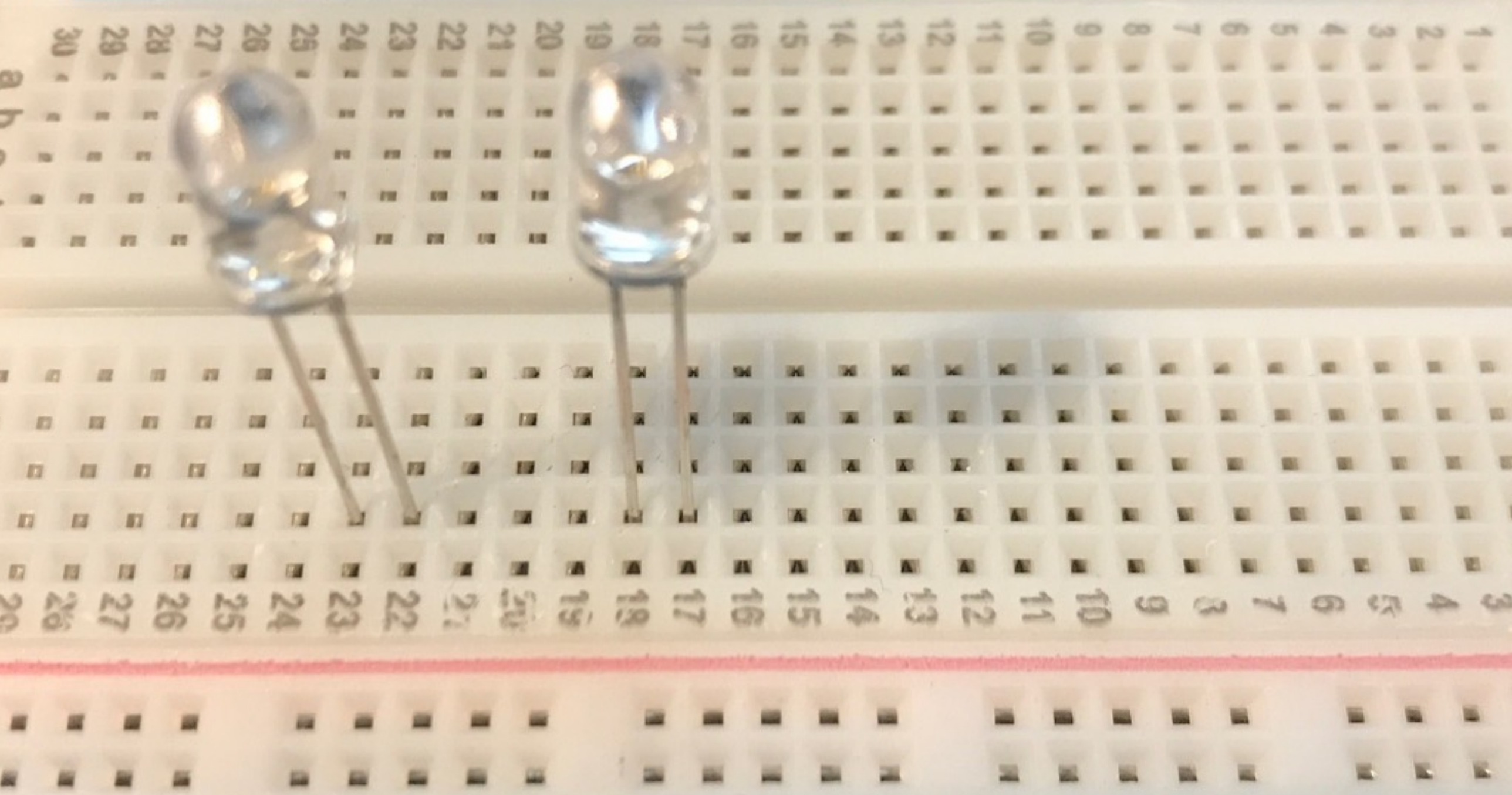
NodeMCU ESP8266 WiFi Module

this is what we use in class

the breadboard

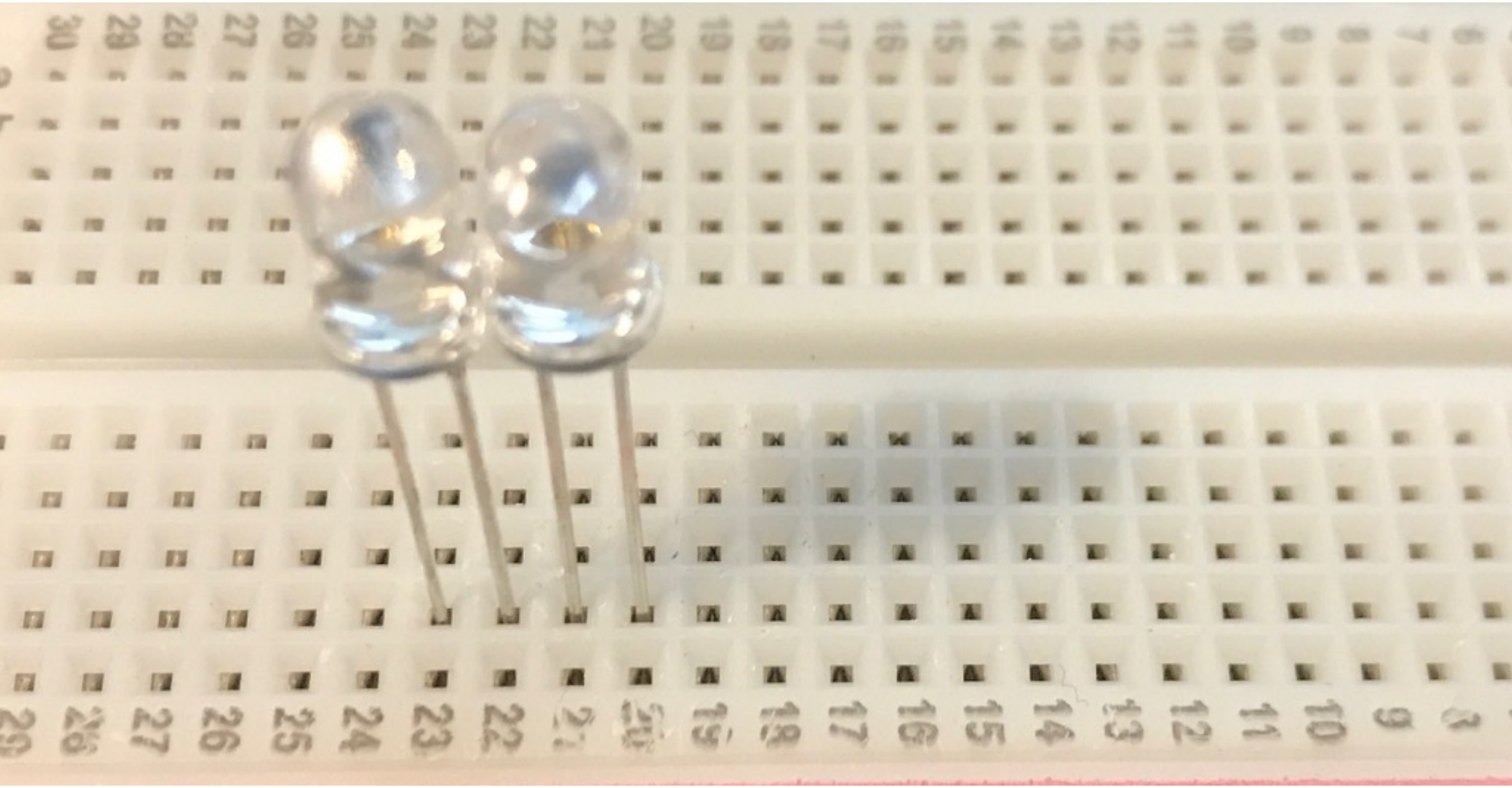

+
−
a b c d e
f g h i j
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30


+
−
a b c d e
f g h i j
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30



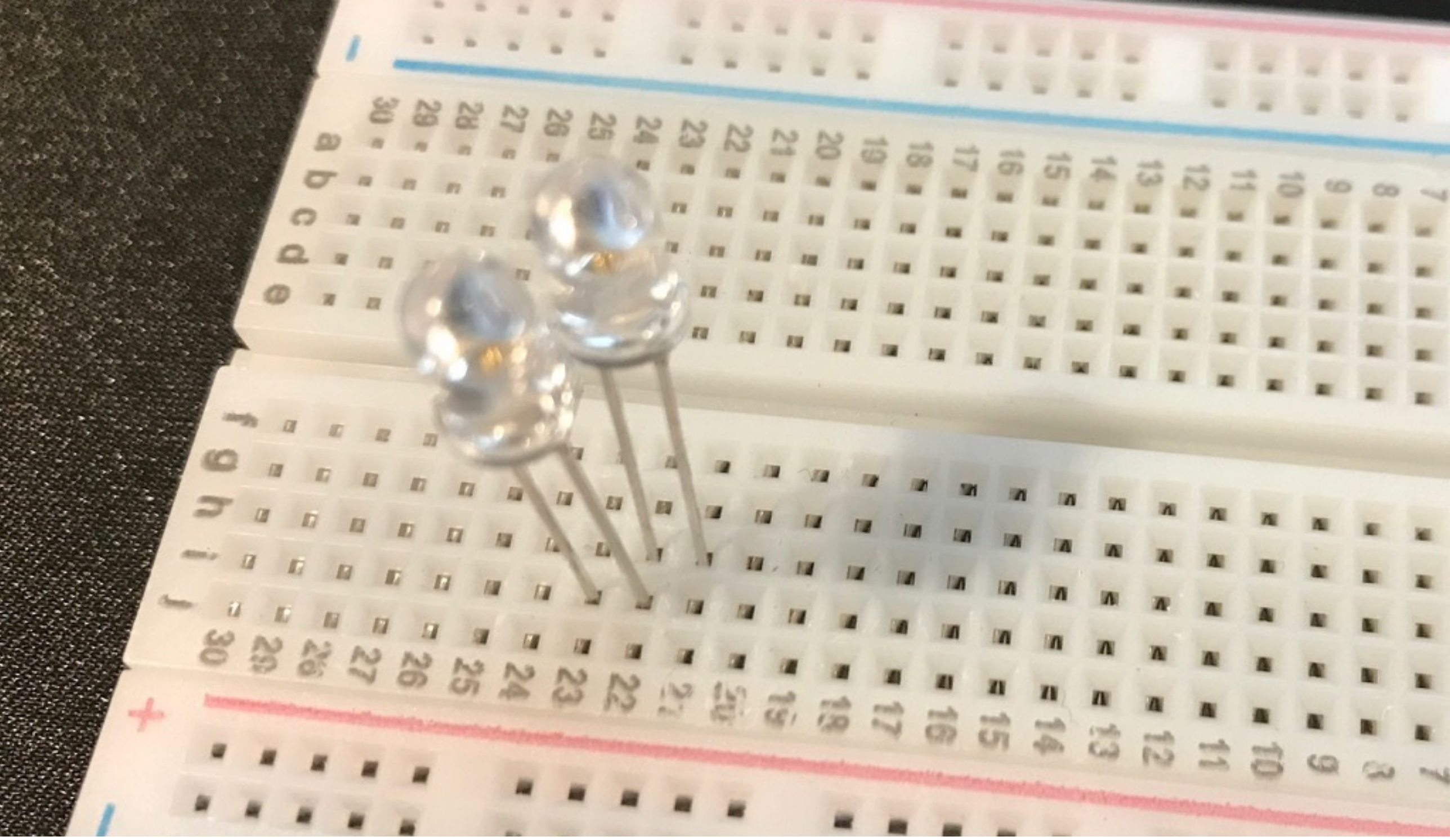
are the LEDs connected with each other?

<30s brainstorming>



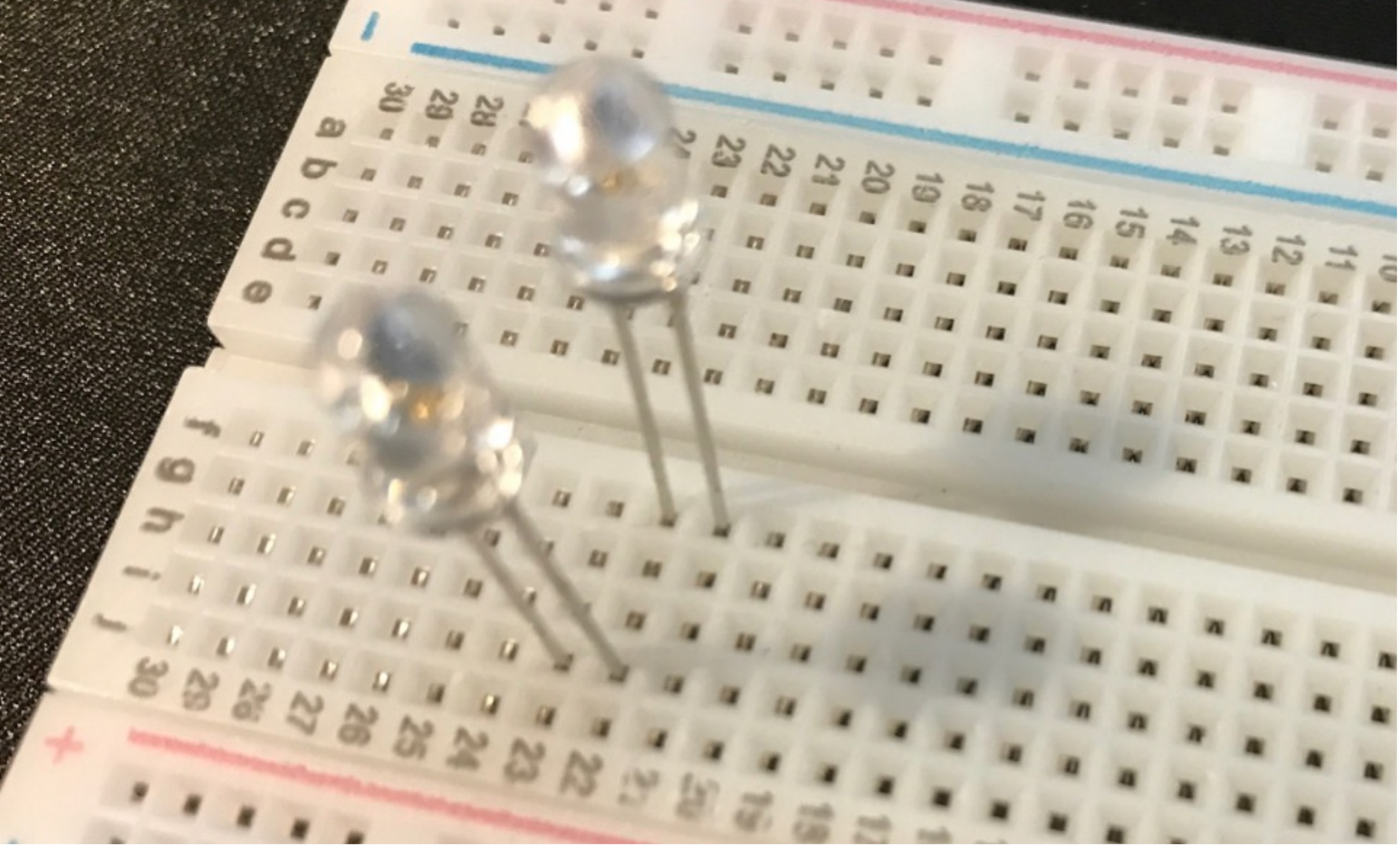
and here?

<30s brainstorming>



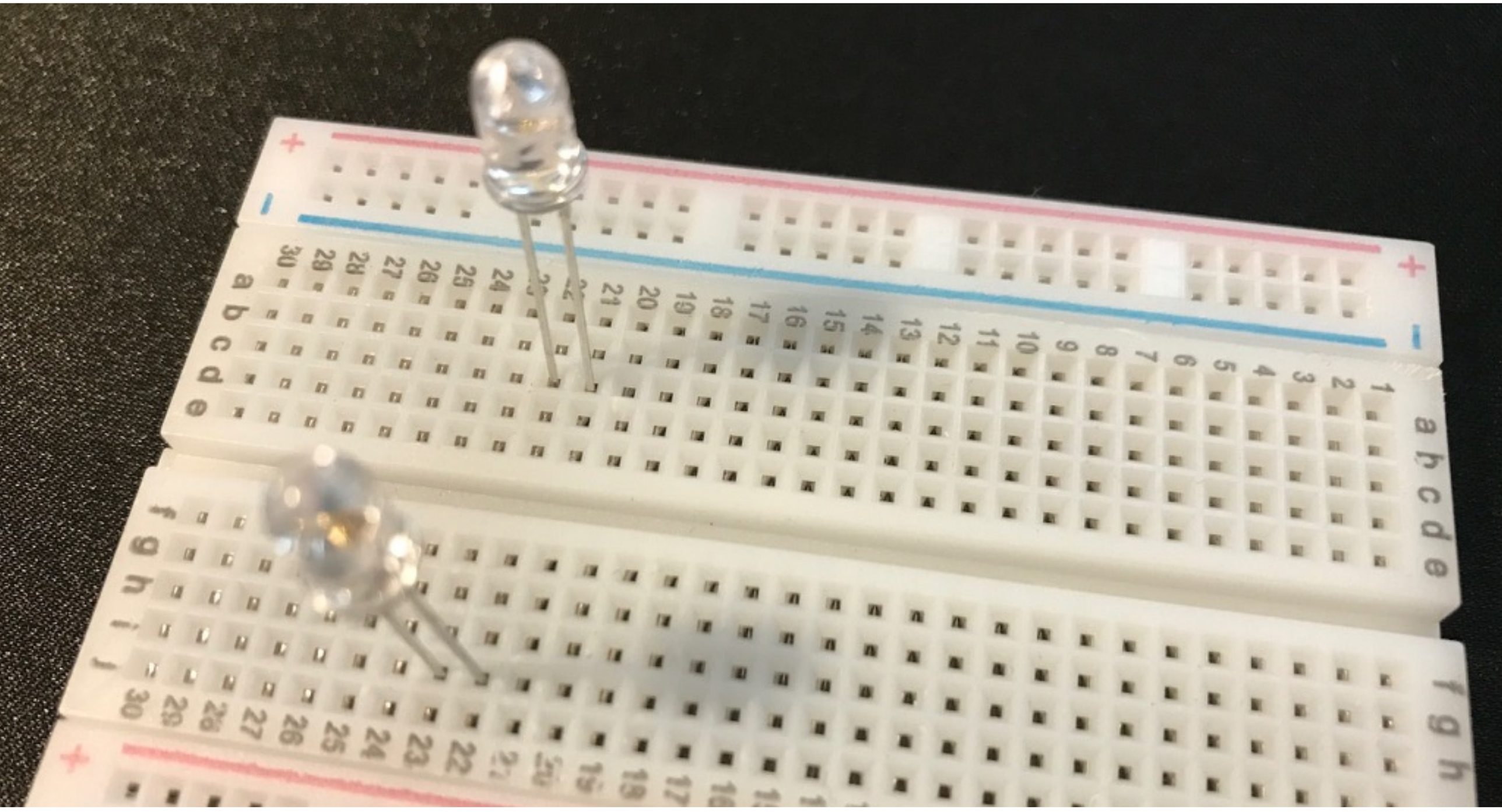
now?

<30s brainstorming>



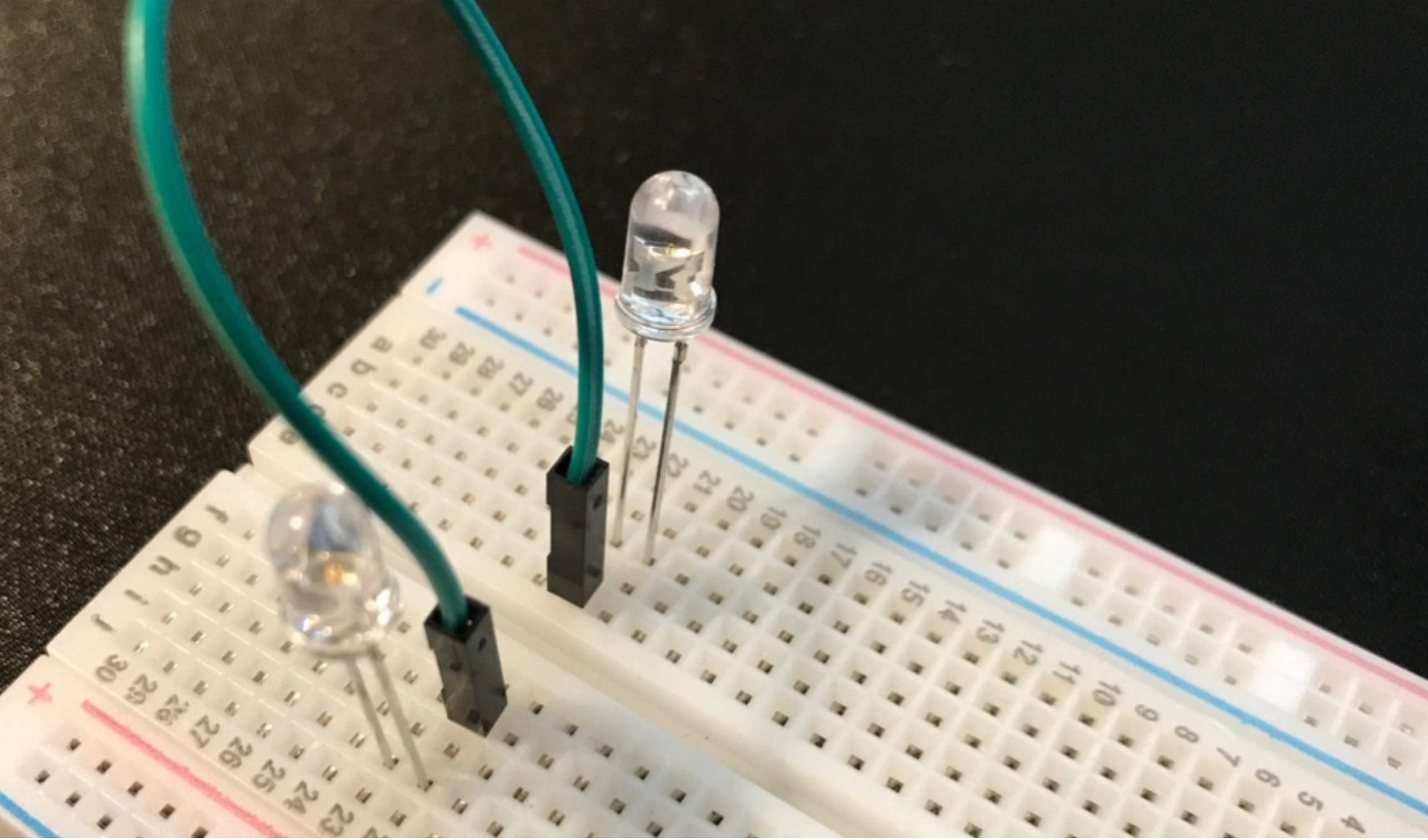
and here?

<30s brainstorming>



how about this?

<30s brainstorming>



would using a cable fix it?

<30s brainstorming>

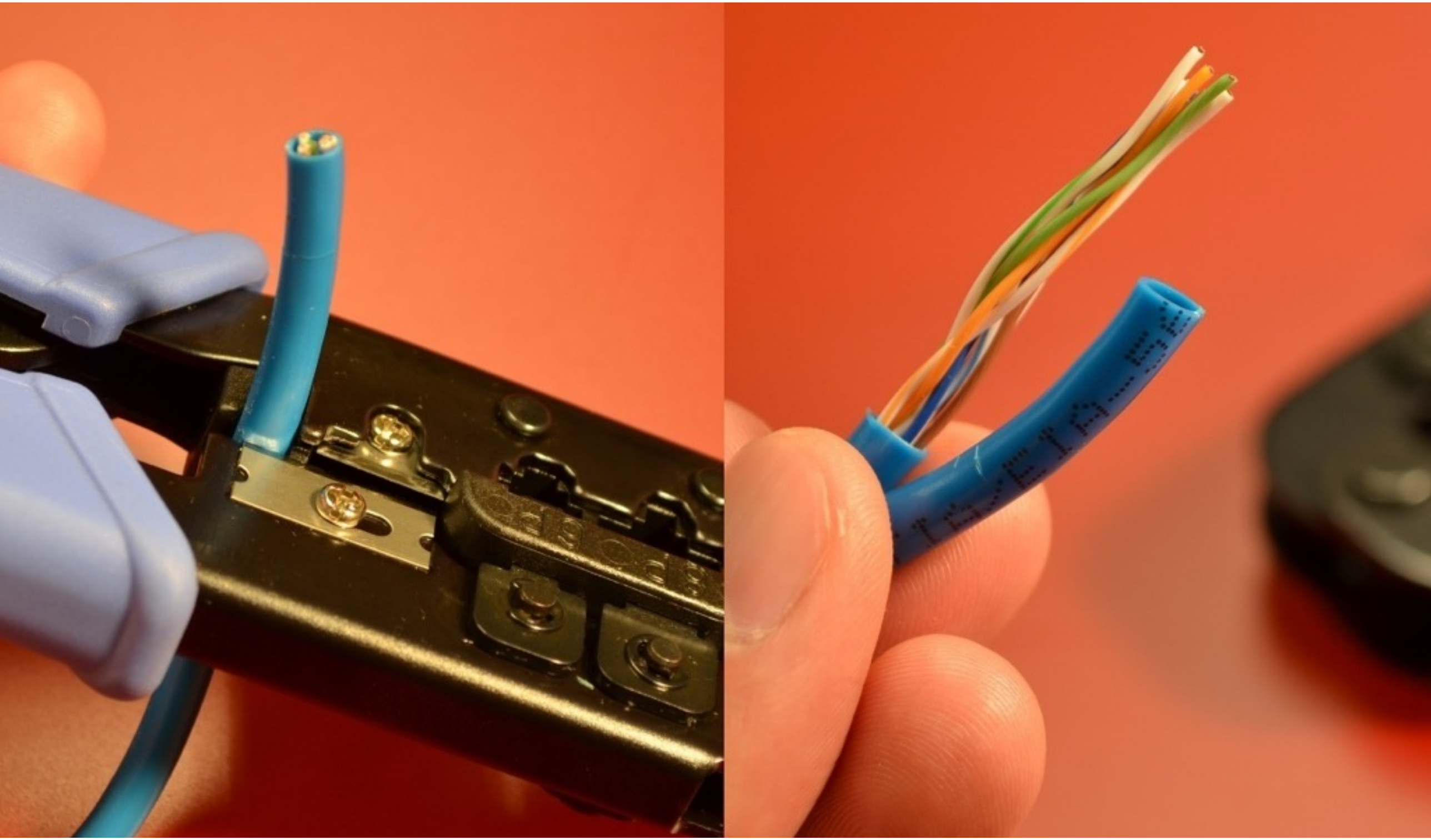
cables

prototyping cables
for your breadboard…

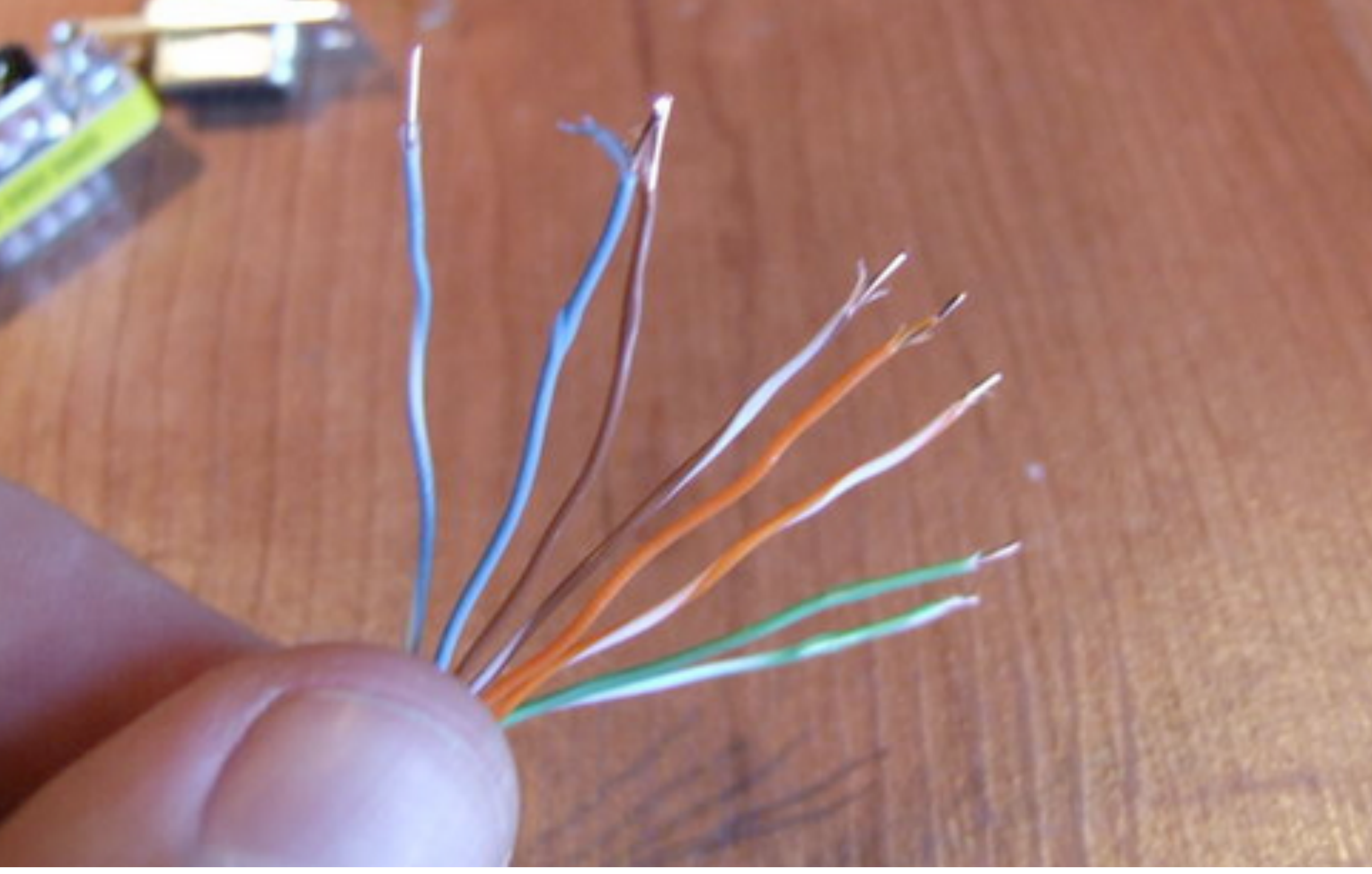
it’s just a normal cable, nothing special about it…
you can make your own!

EDS cable stand: cut a piece of cable from the roll

use a cable crimper (or scissors)



insert cable into crimper, then rip off front

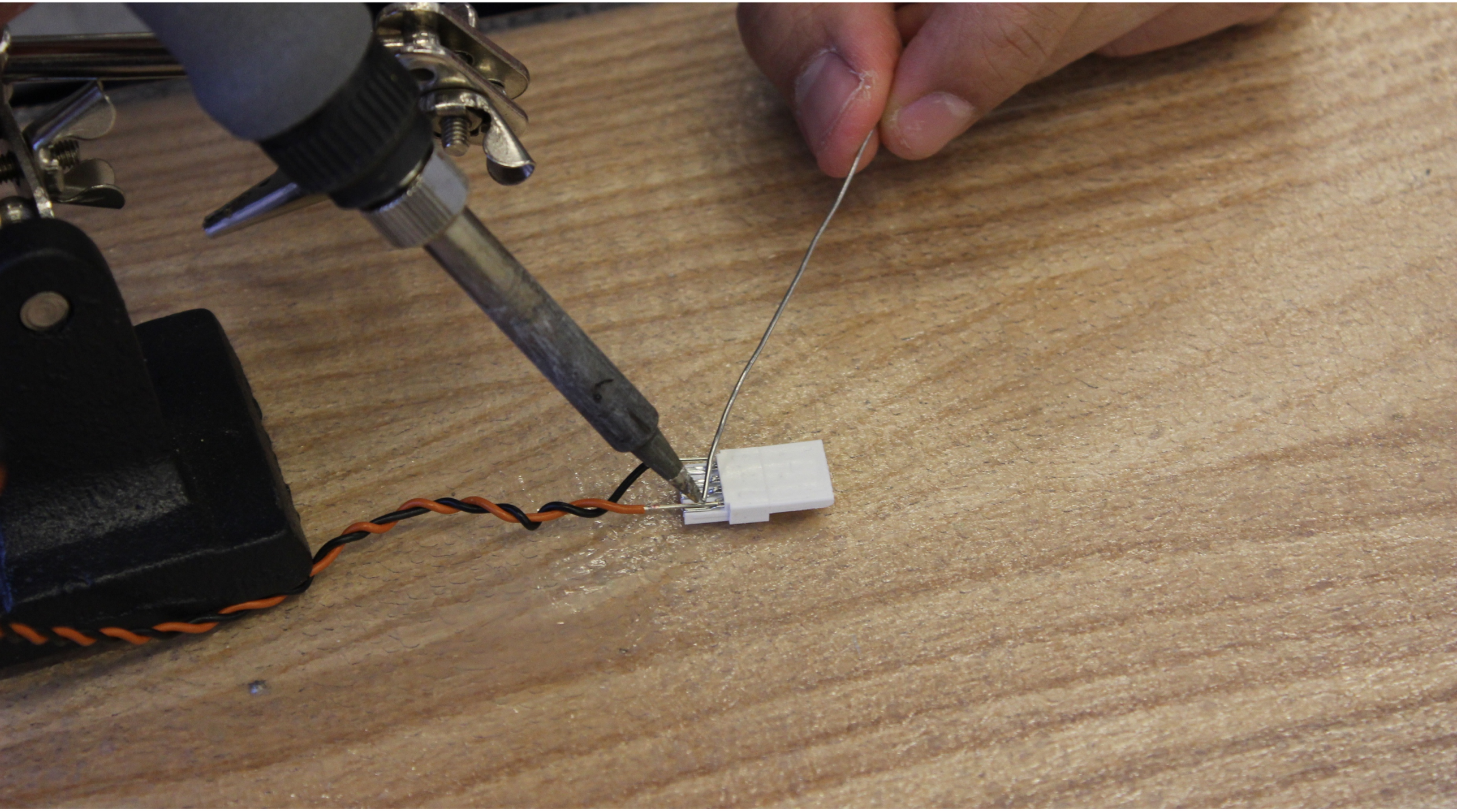


now you can **plug it into the breadboard**

let’s do this!

- cut a piece of cable from a cable role
- peel of the plastic from each side
- use in your breadboard

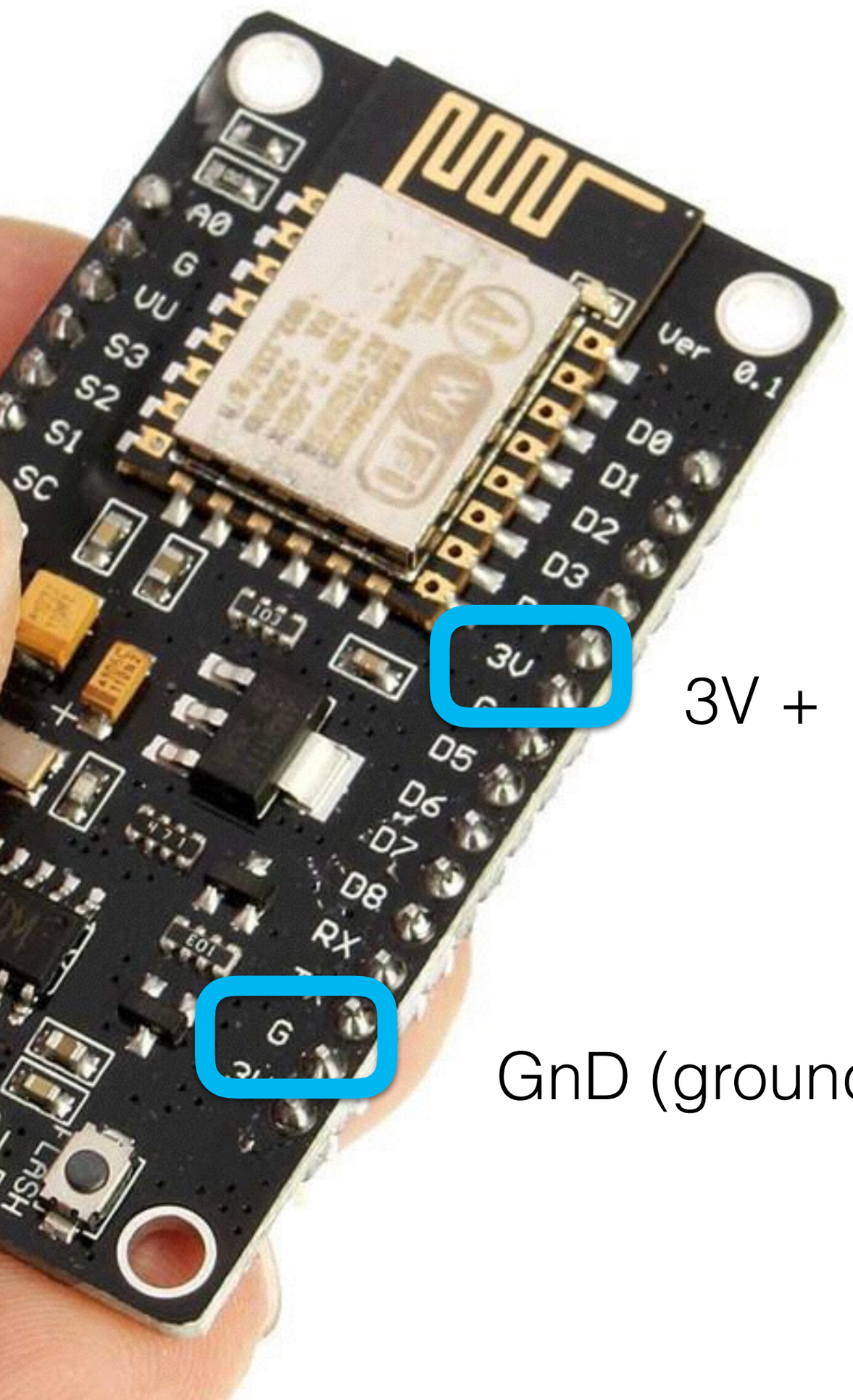
<2 min>



- for many things, you need **two cables** (e.g. for USB)
- one connected to + and one connected to -

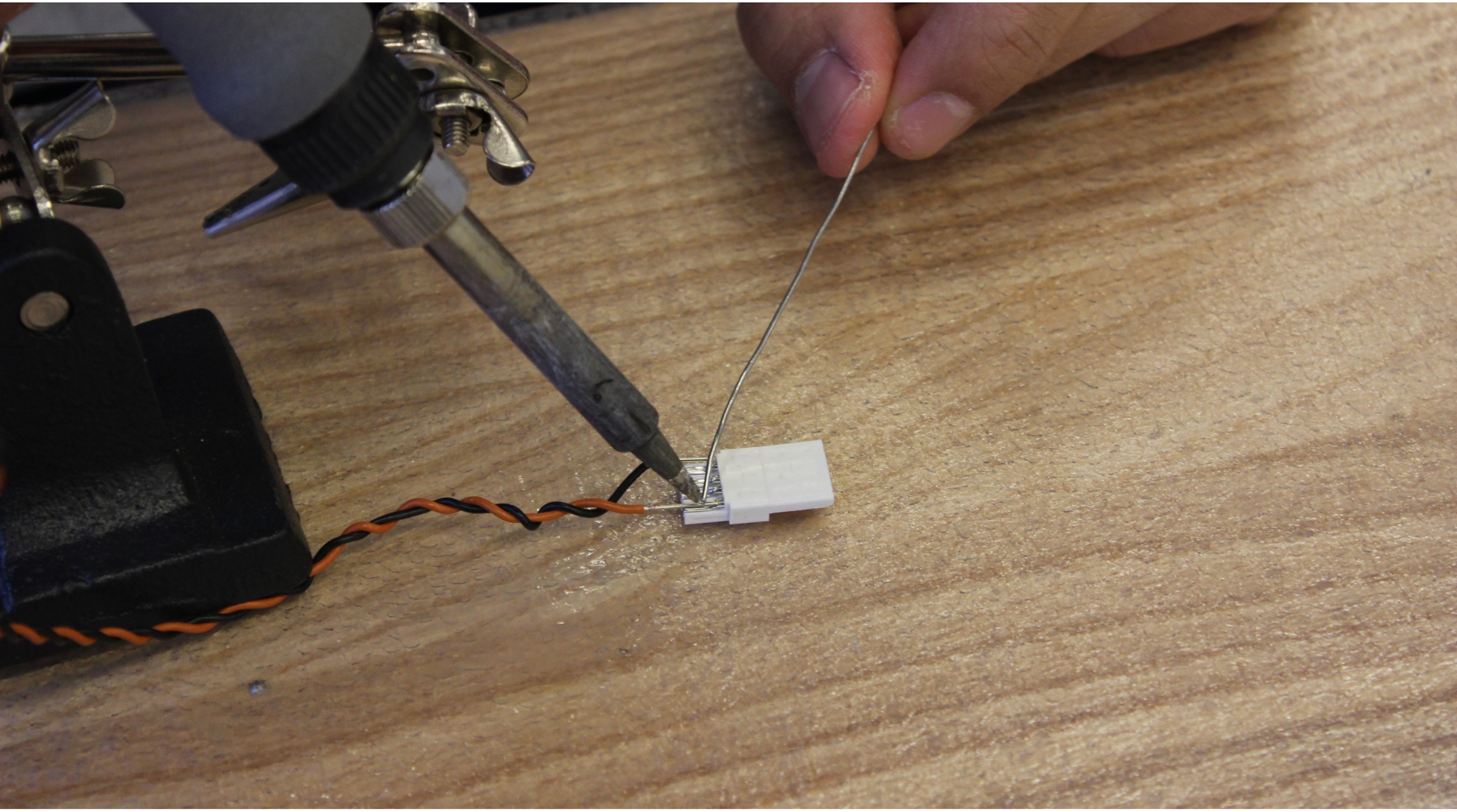
where is + and - on the controller?

<30s brainstorming>

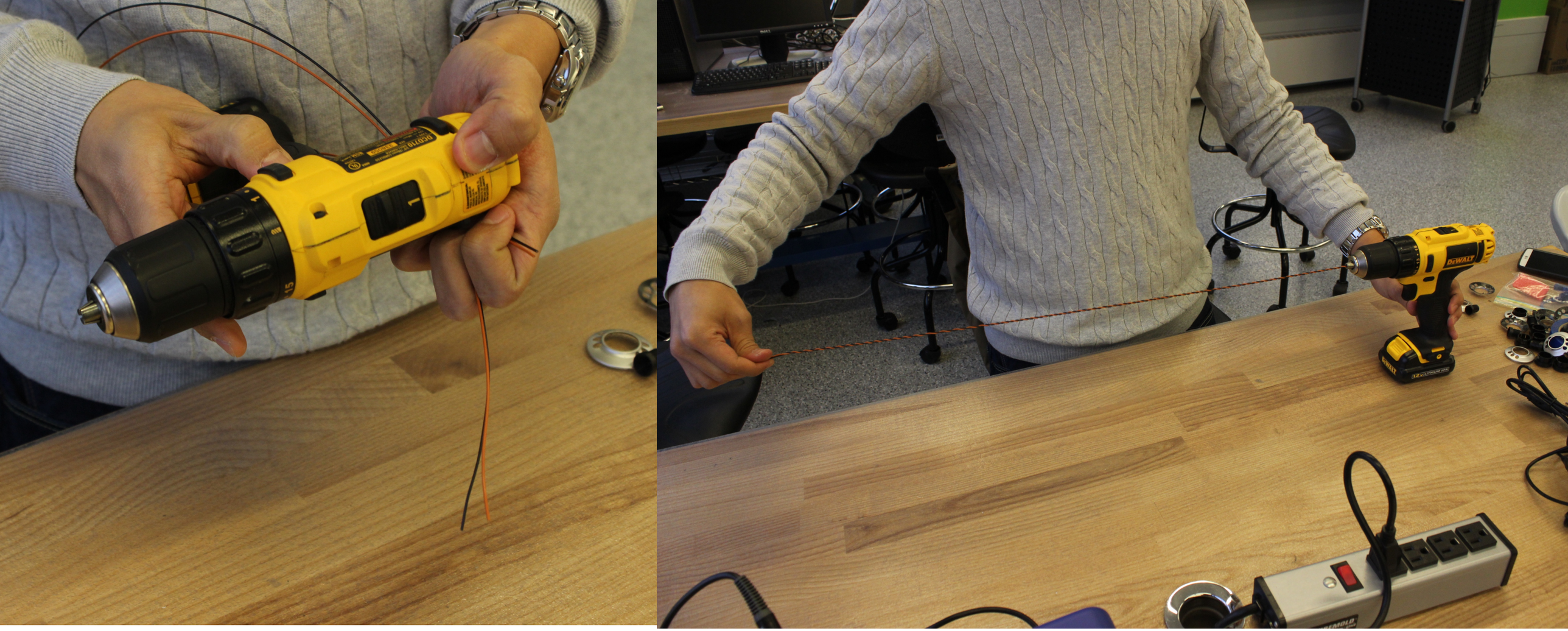


3V +

GnD (ground) -



twisting both cables allows to hold them in place together

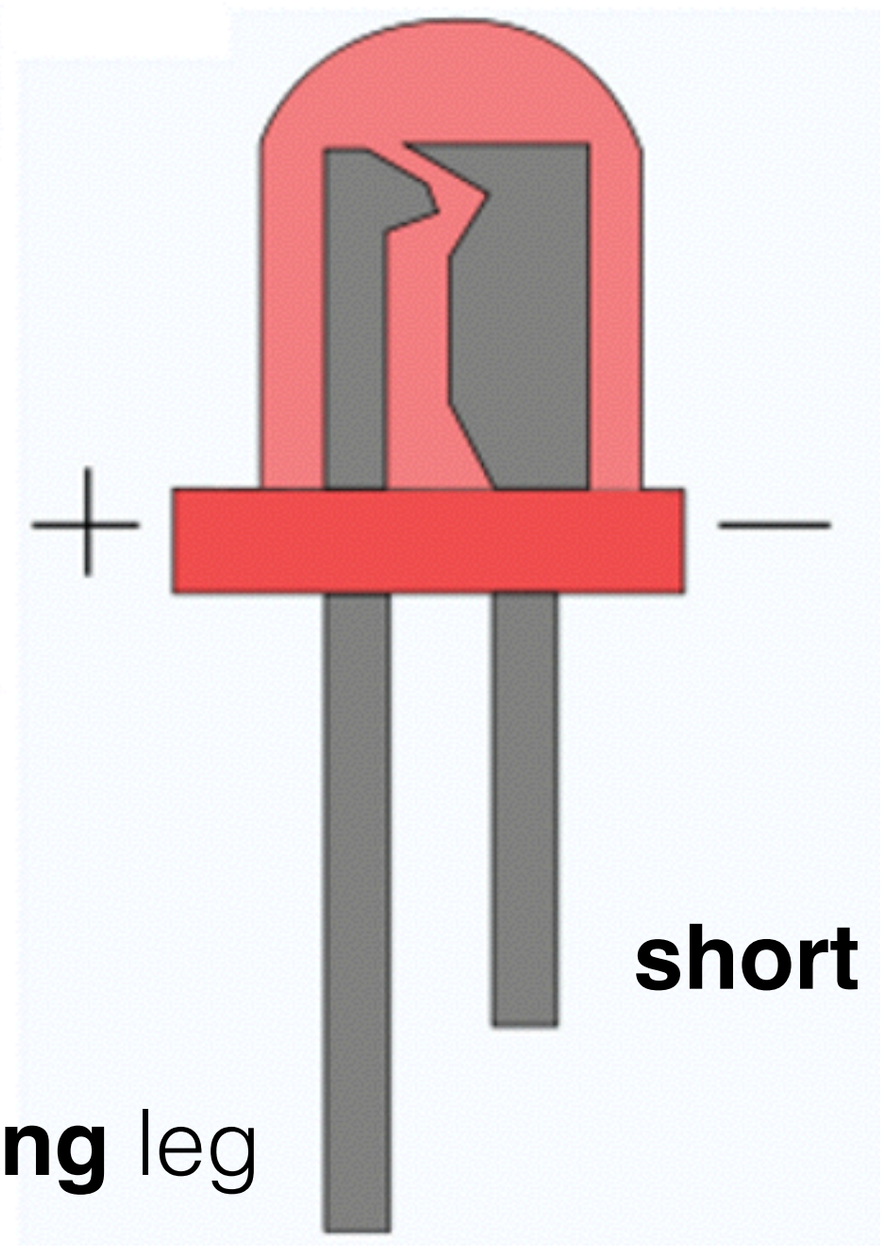


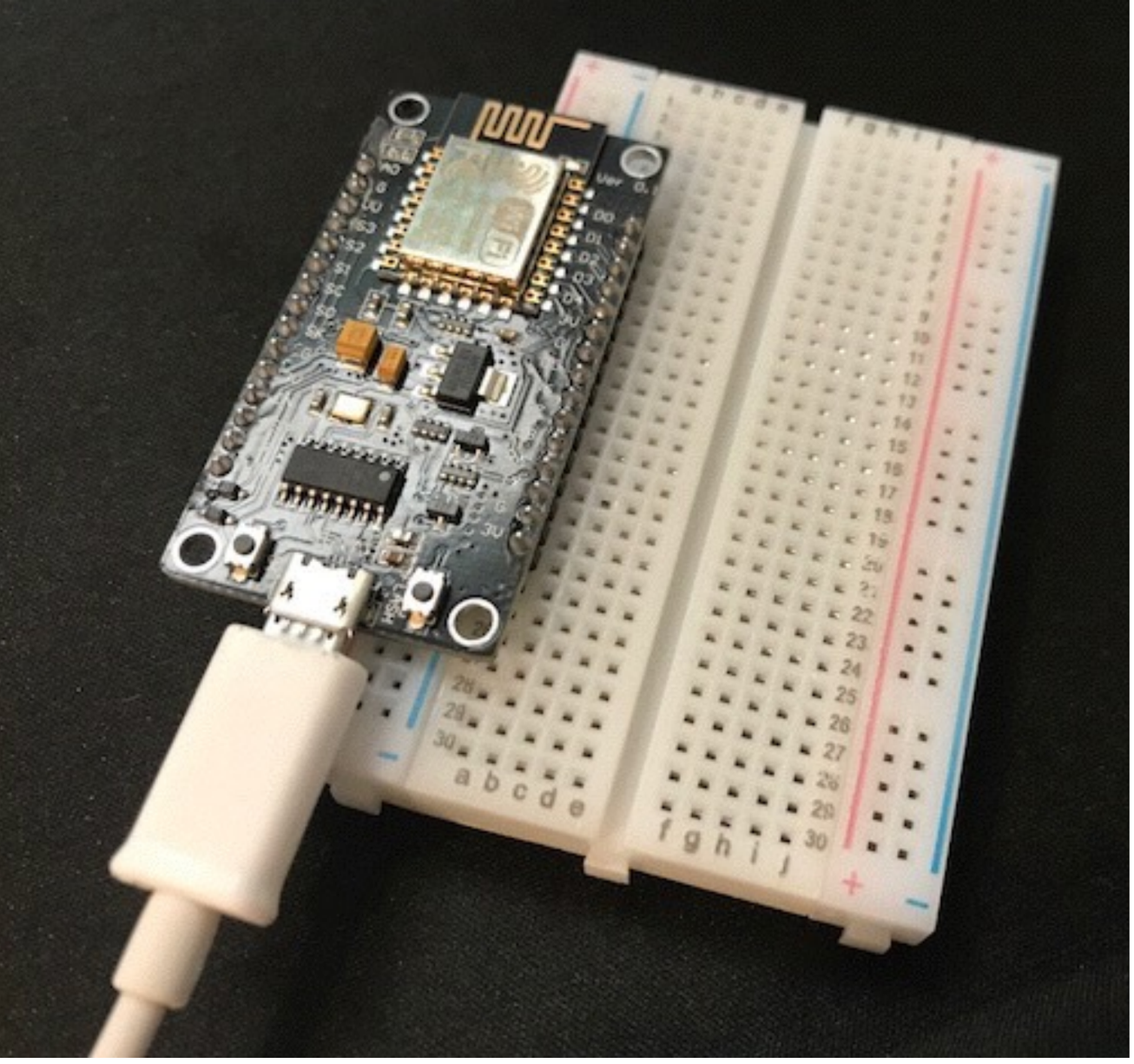
making a twisted cable with +/-

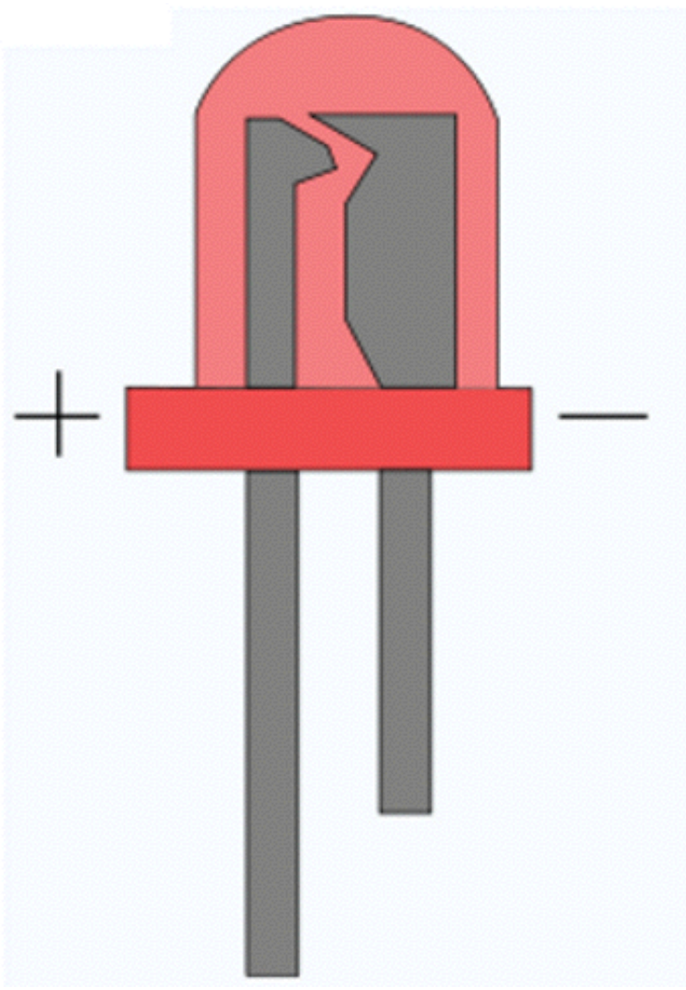
- quick demo

<1 min>

connecting an LED


+
−
short leg
long leg

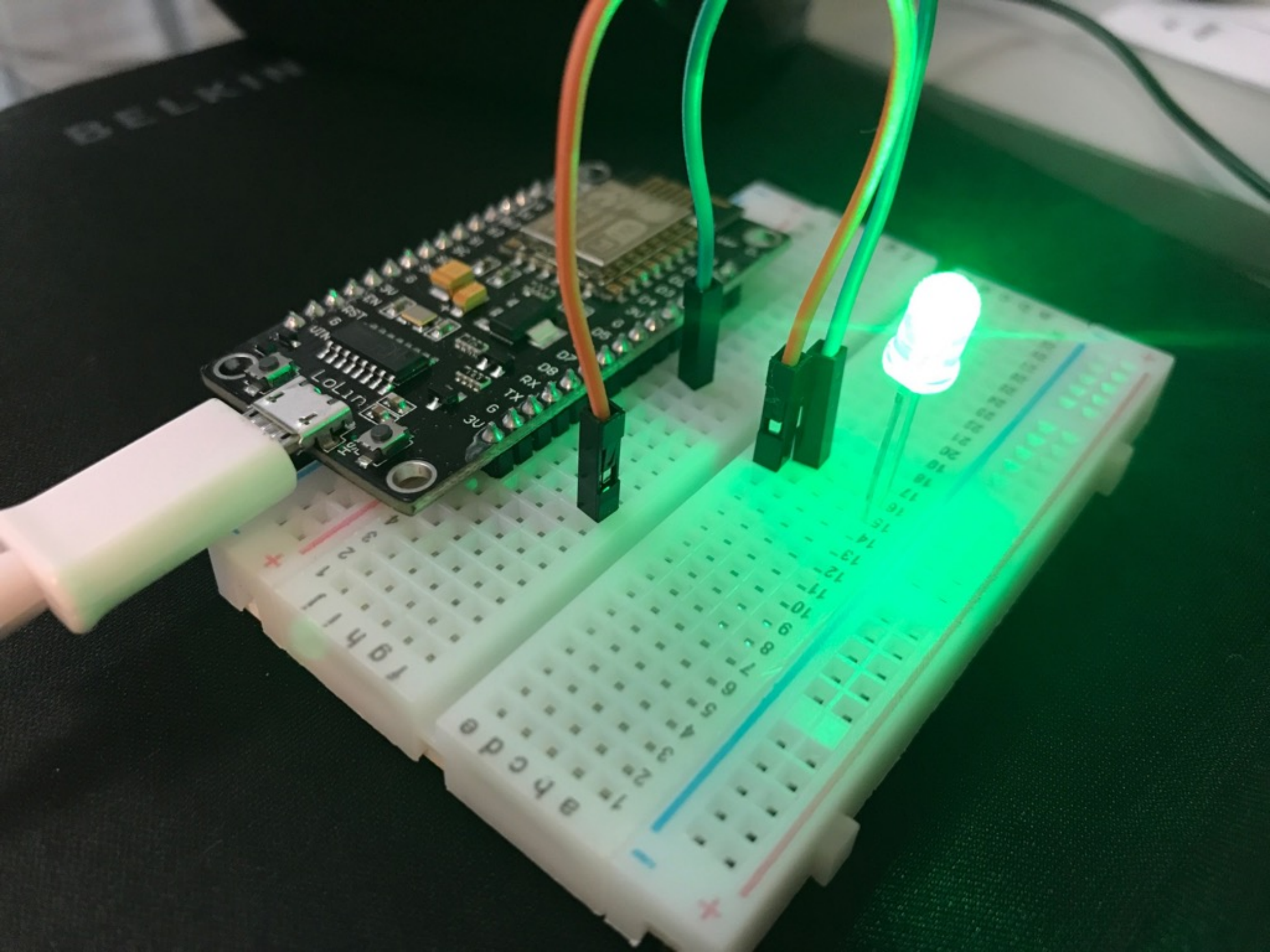




let’s connect the LED to 3V and G to turn it on
(use prototyping cables)

<2 min>

once it’s on, please disconnect again
(it will fry after a while because we miss a resistor)


BELKIN
LoLin
3V
EN
RST
VIN
D7
D8
RX
TX
G
3V

basic circuit math

need to know **required voltage and current** for each circuit component

	7500 mcd	50 mA	2.1 V

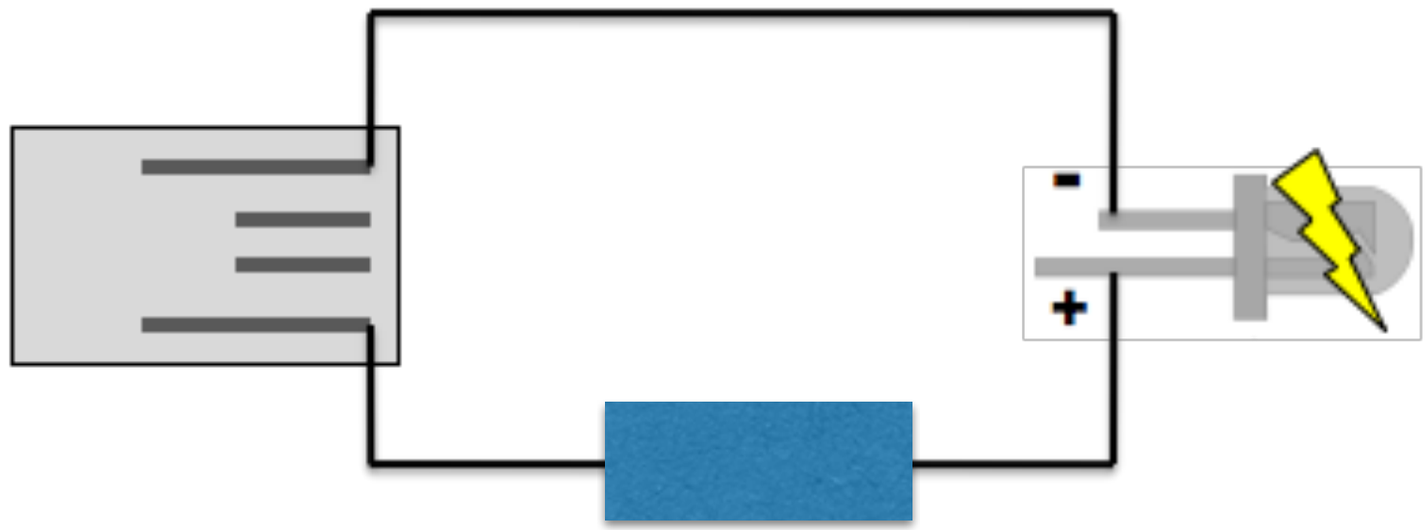
http://www.mouser.com/Optoelectronics/LED-Lighting/LED-Emitters/Standard-LEDs-Through-Hole/_/N-b1bc8

3.3V
on ESP

2.1V
20mA

blows up the LED

3.3V
on ESP



2.1V
20mA

add a **resistor**
(lowers the current)

many different resistors, which one should we use?

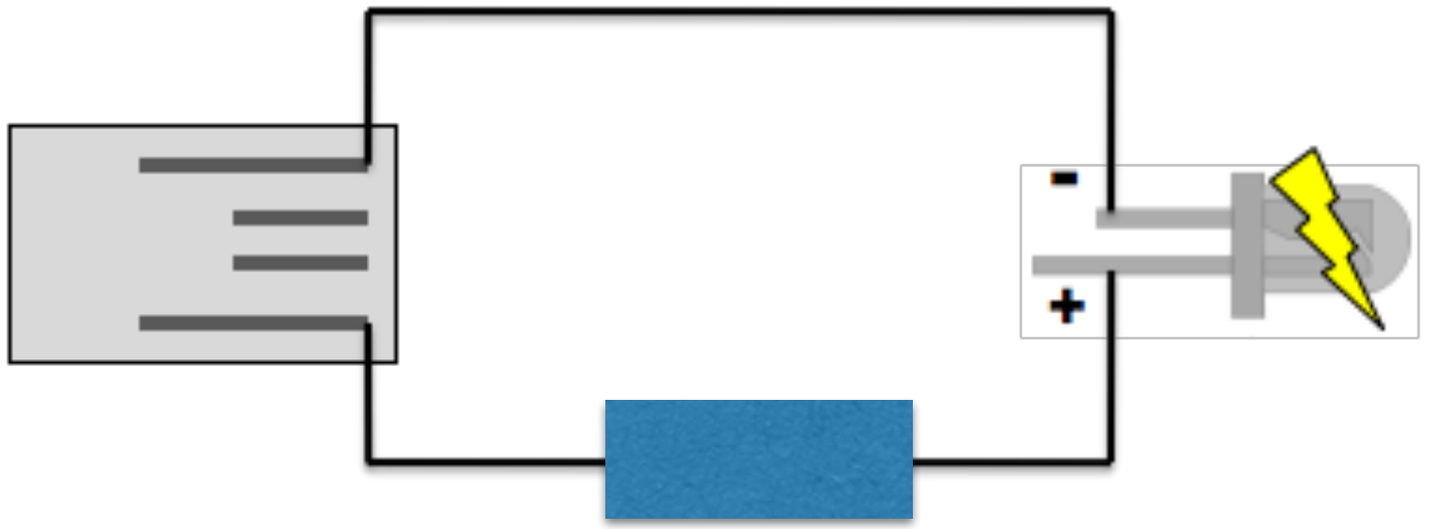
Ohm's Law!
$\Delta V = R * I$

ΔV = given
I = given
R = ?

let's do the math!

<2 min>

3.3V on ESP



2.1V 20mA

add a **resistor**
(lowers the current)

Ohm's Law!

$\Delta V = R * I$

$\Delta V = 3.3V - 2.1V$

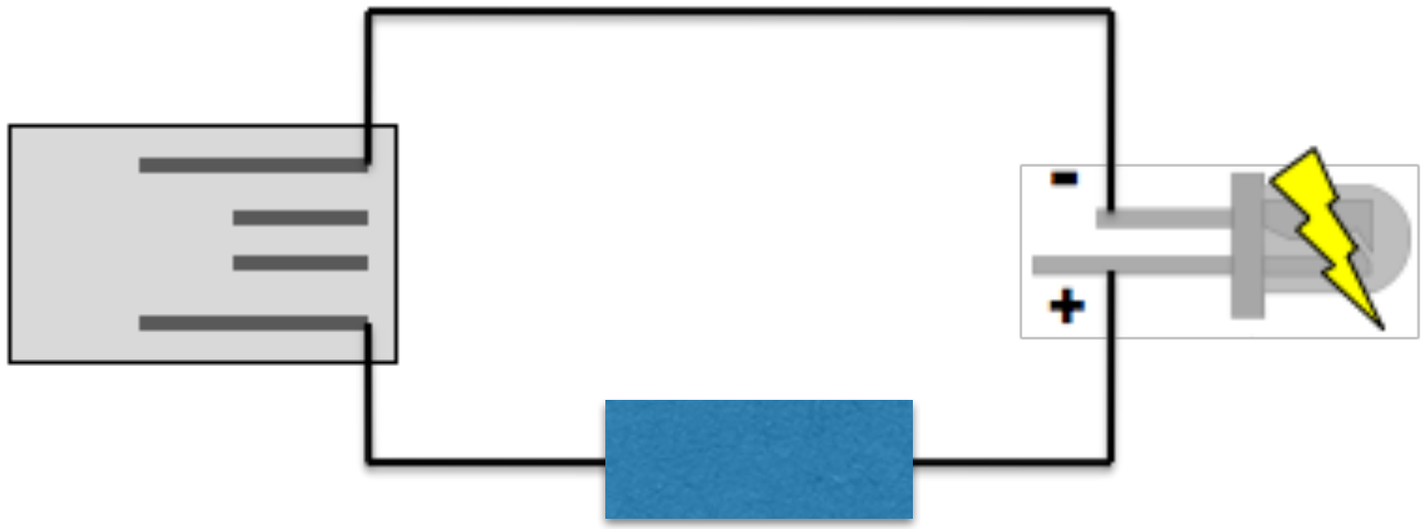
$I = 20ma$

R = ?

$$R = \frac{3.3V - 2.1V}{0.02A}$$

$R = 60\Omega$ (ohm)

3.3V on ESP



2.1V 20mA

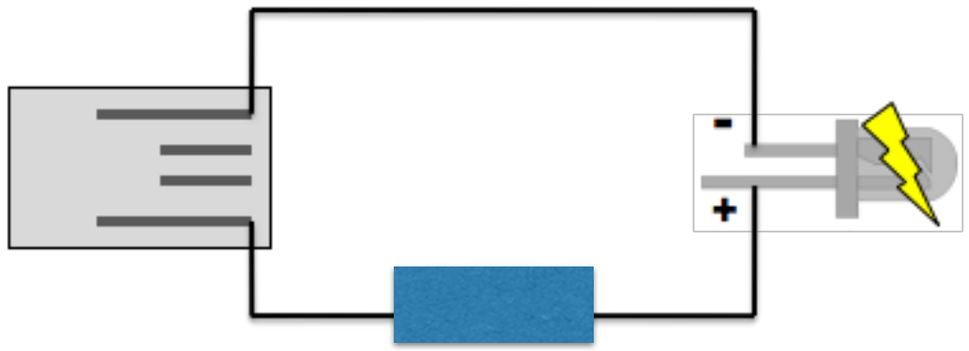
R = 60Ω

resistor

> 60Ω causes LEDs to be less bright

< 60Ω might blow up LEDs

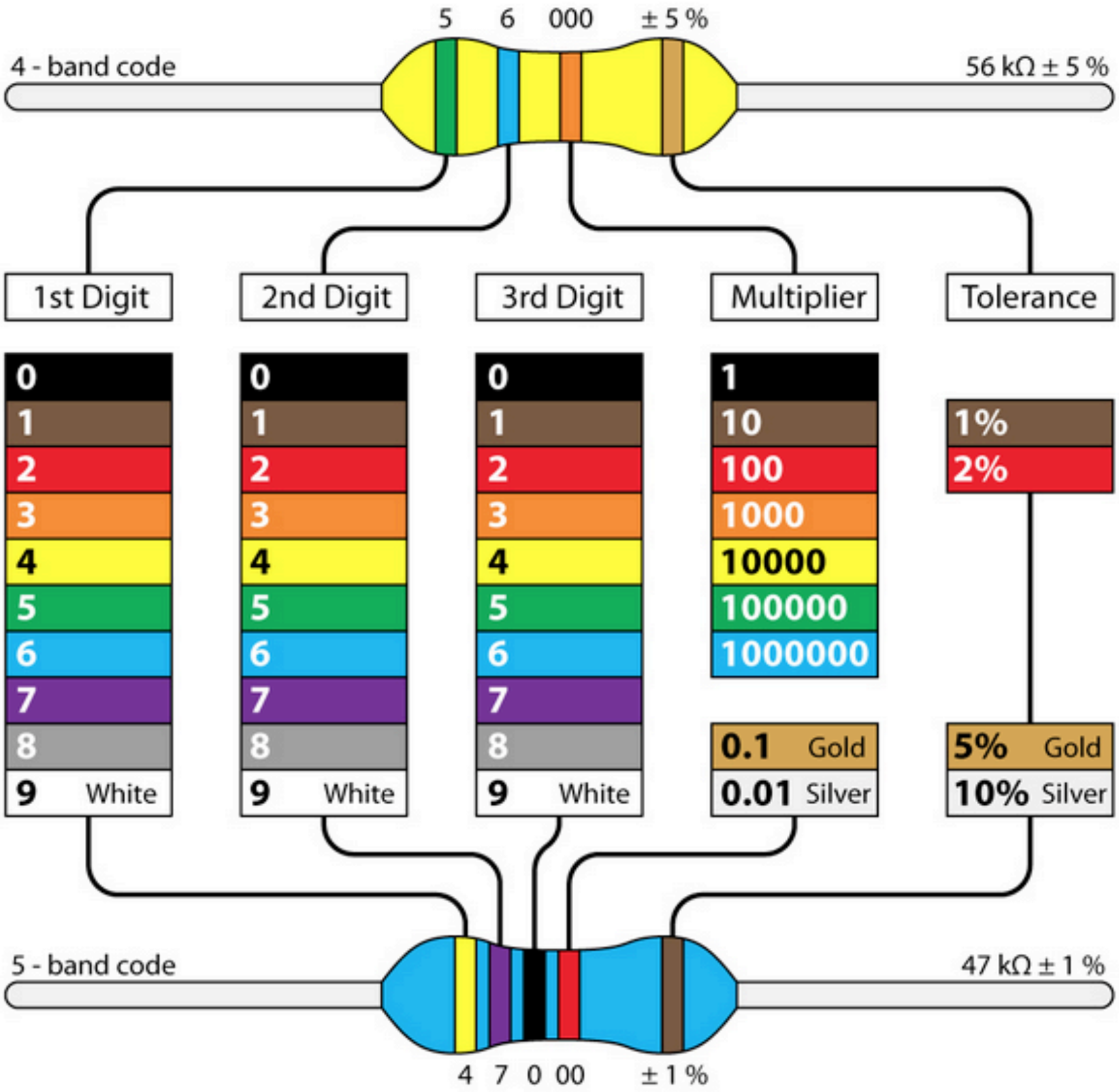
3.3V



White LED
3.8 V
20 mA

but which one is it?

Resistor colour code



Resistor color code calculator

60

Ω

1% (5 bands)

Display resistor

60Ω 1%

Blue, black, black, gold, brown.

Non-Standard
1% (E96) value.

1. band | 2. band | 3. band | 4. band | none | Calculate

Select bands

Reset

Help

4 and 5 band resistor color code calculator

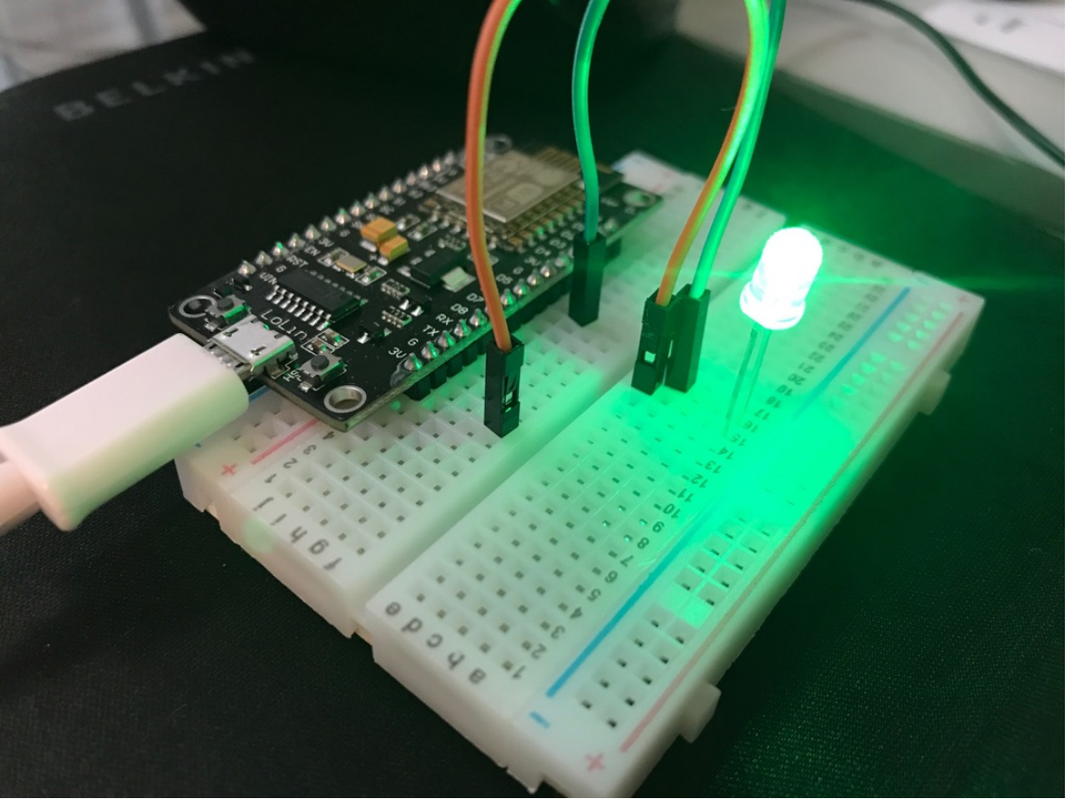
©hobby-hour.com

The calculator above will display the *value*, the *tolerance* and performs a simple check to verify if the calculated resistance matches one of the EIA standard values. Select the *first 3 or 4 bands* for 20%, 10% or 5% resistors and *all 5 bands* for precision (2% or less), 5-band resistors. Hover above the tolerance for min. and max. range values.

If you want to find out the color bands for a value, use the tool on the left. Enter the value, select the multiplier (Ω, K or M), the desired precision and hit 'Display resistor' or ENTER. You can also type in resistor values in *shorthand notation* like 1k5, 4M7 or 100R.

shoutkey.com/**bring**

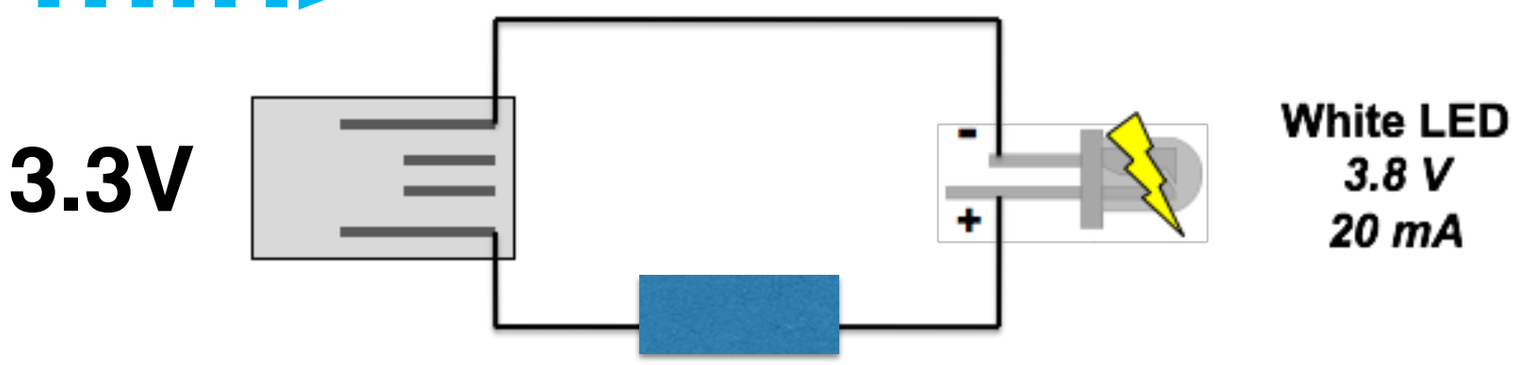
http://www.hobby-hour.com/electronics/resistorcalculator.php

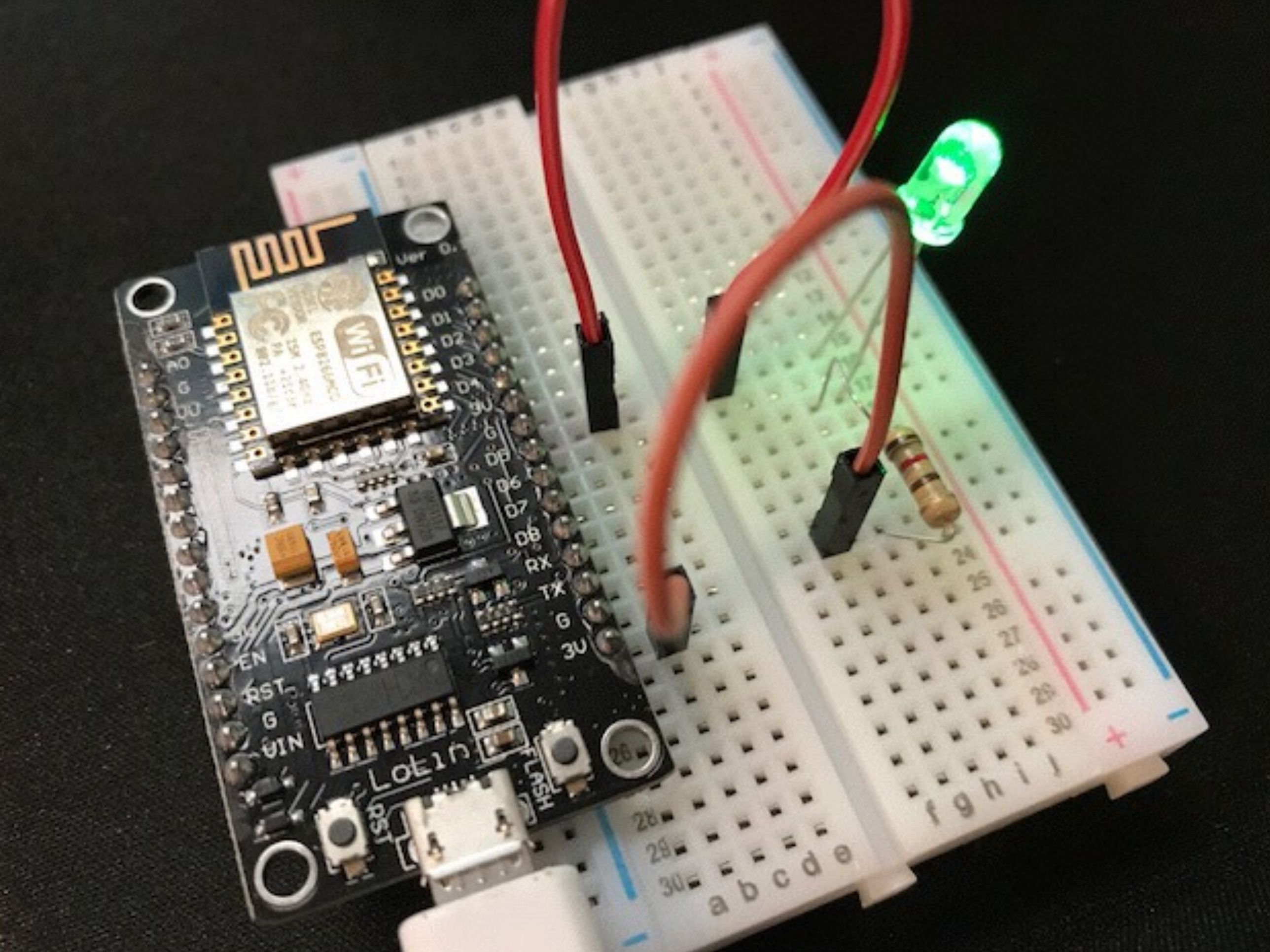


shoutkey.com/**bring**

let’s modify our circuit to include the resistor!
(you should have a 60 ohm resistor in your bag).

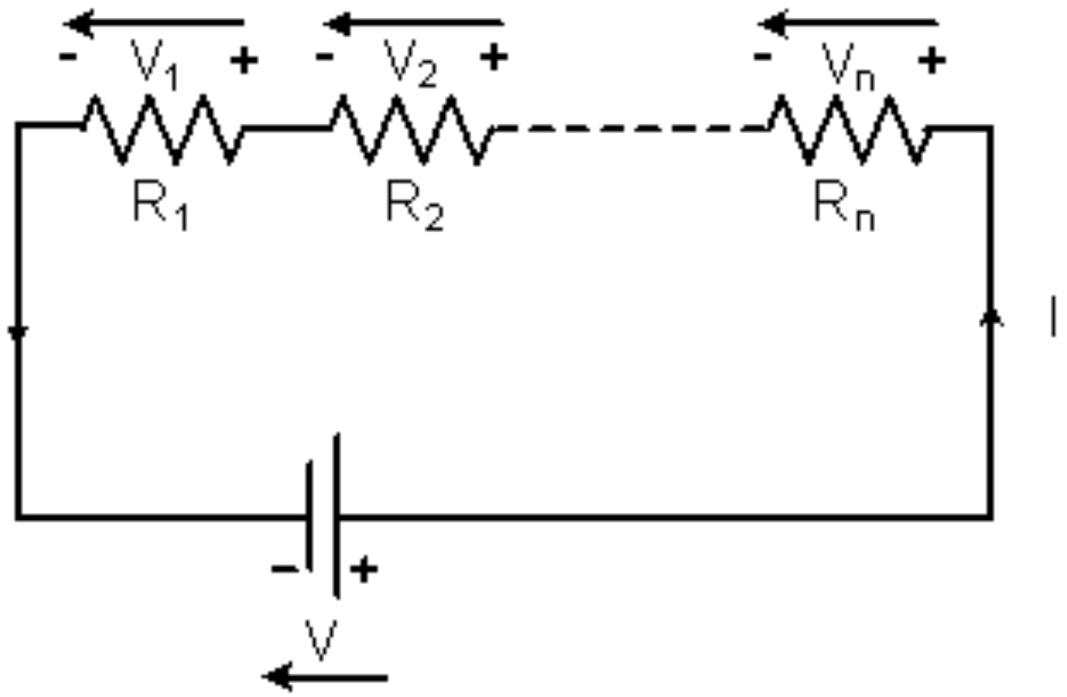
<2 min>



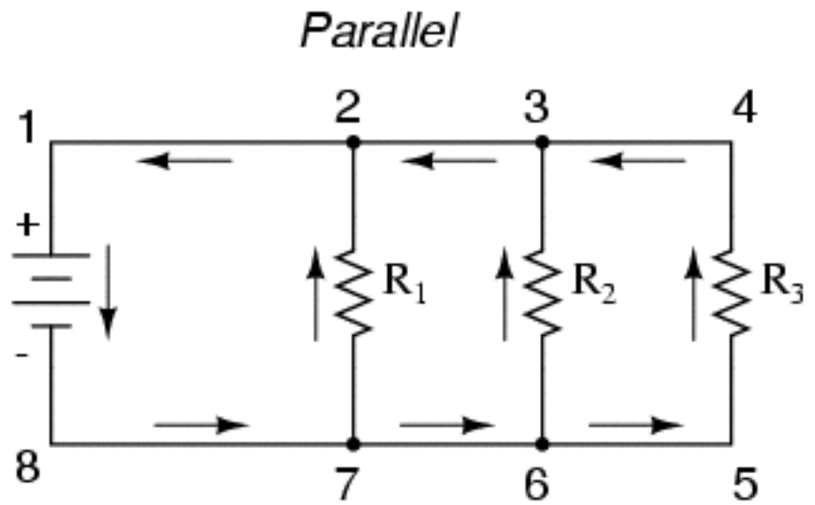

WiFi
D0
D1
D2
D3
D4
3V
G
D5
D6
D7
D8
RX
TX
G
3V
EN
RST
G
VIN
LoLin
RST
FLASH
A0
G
D0
a b c d e
f g h i j
+
-

serial and parallel circuits

serial circuit

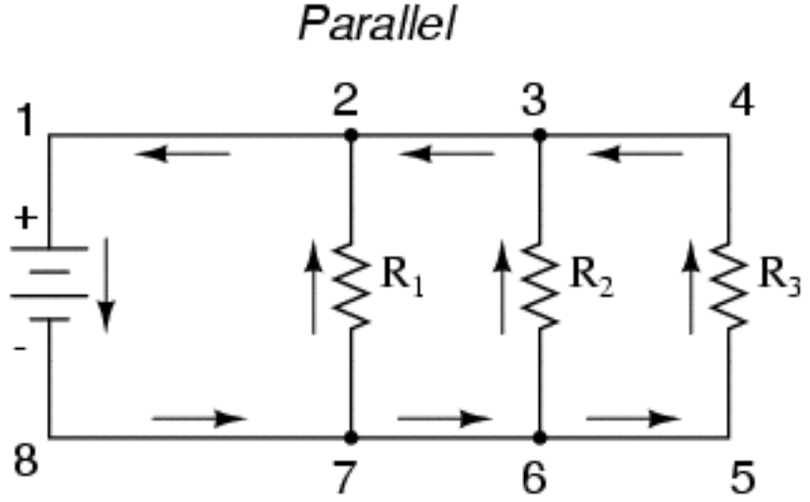


parallel circuit

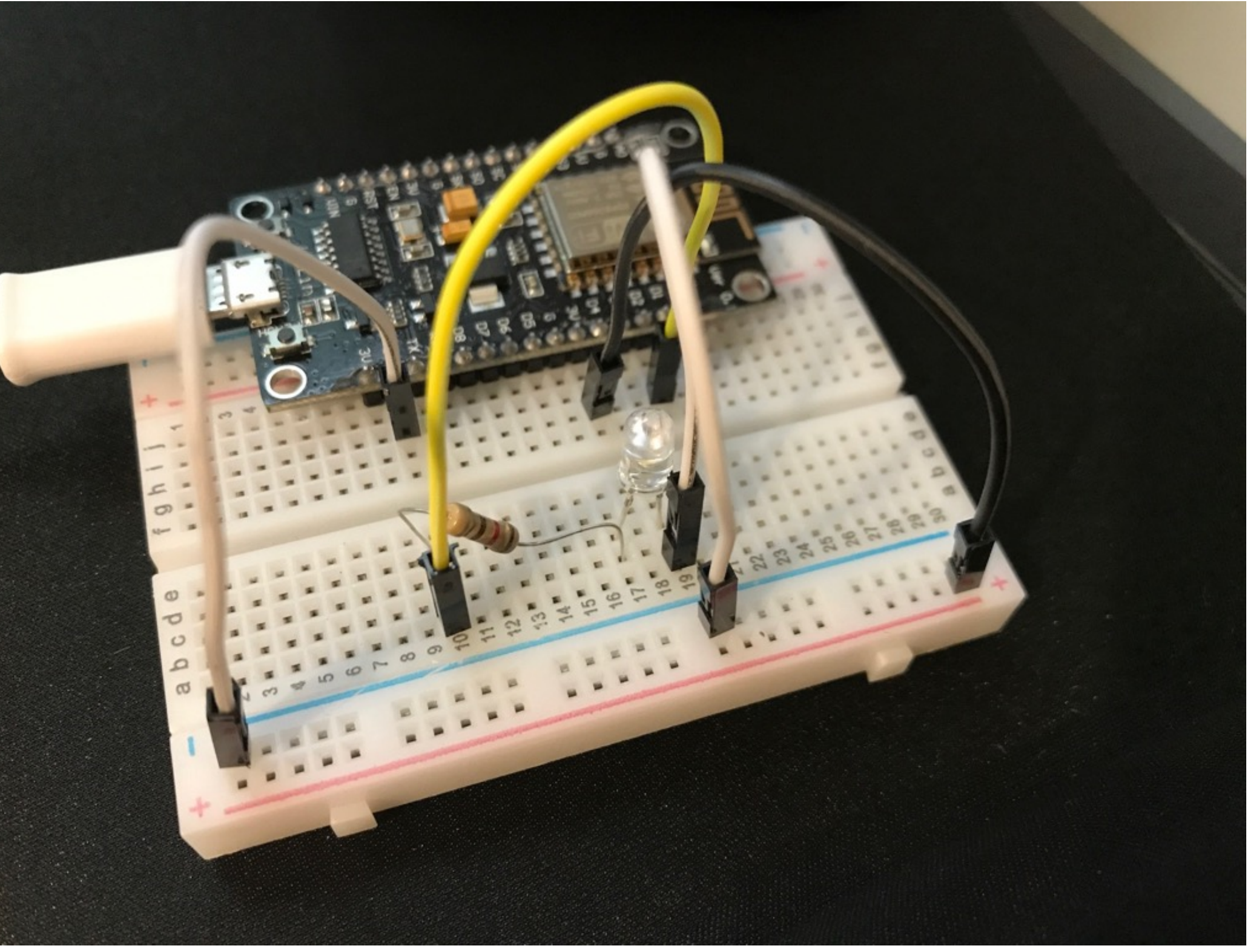


this is what you need for your multi-touch pad:

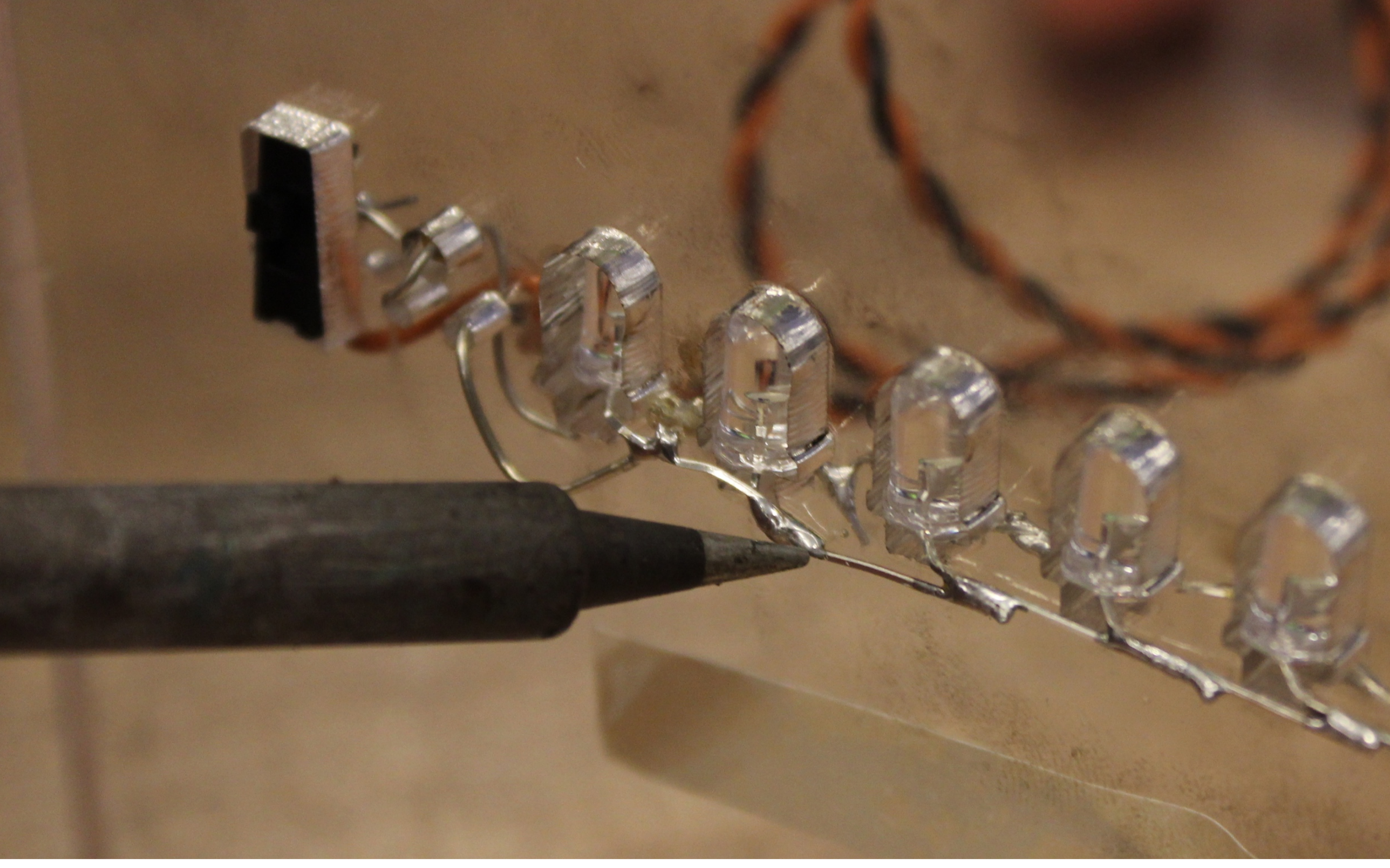
$$R = \frac{3.3V - 2.1V}{0.02A * \#\ of\ LEDs}$$



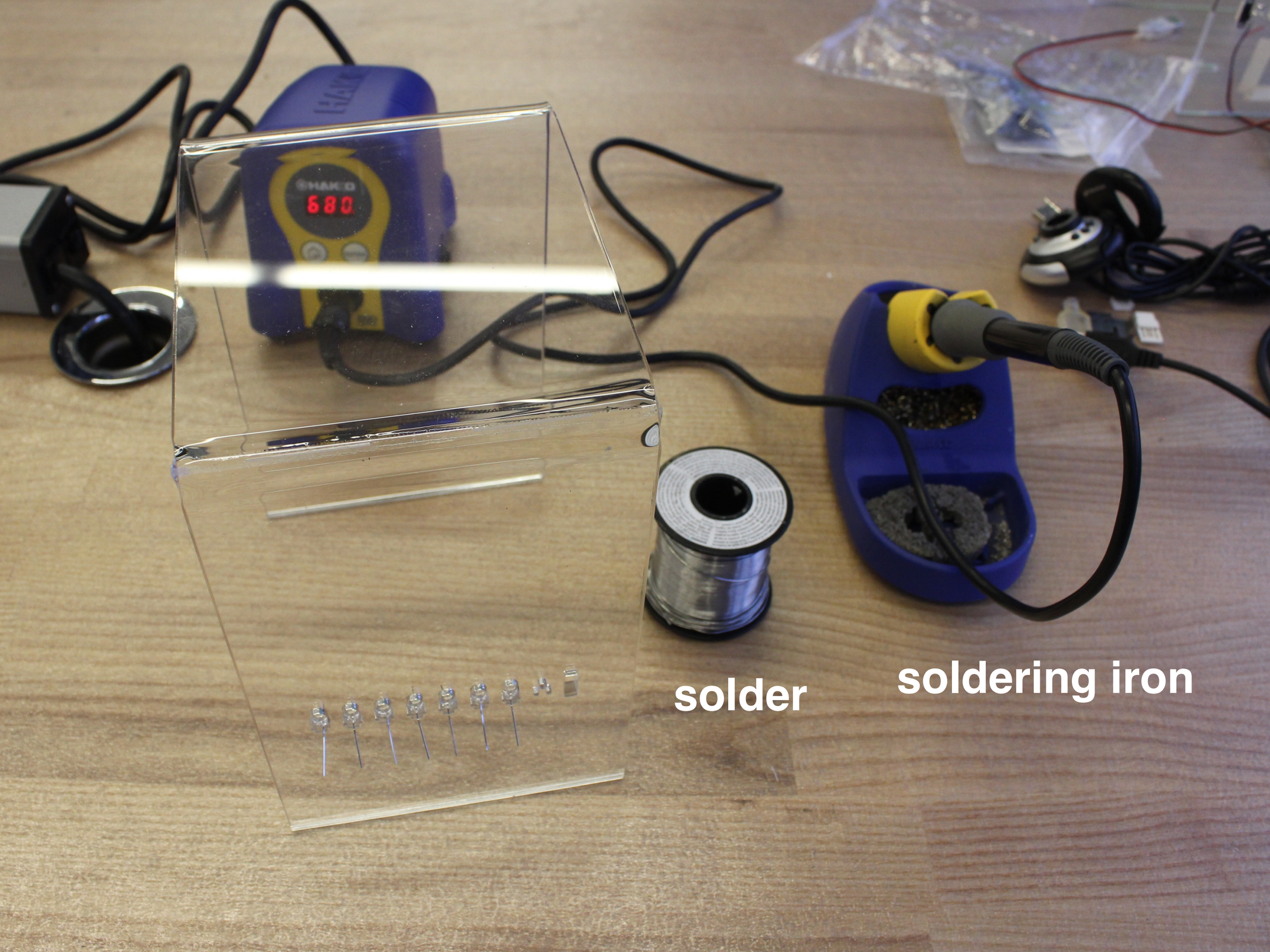
soldering & summary



prototyping cables are great for **iterating and testing**
but they easily fall off and disconnect



solder for permanent connection

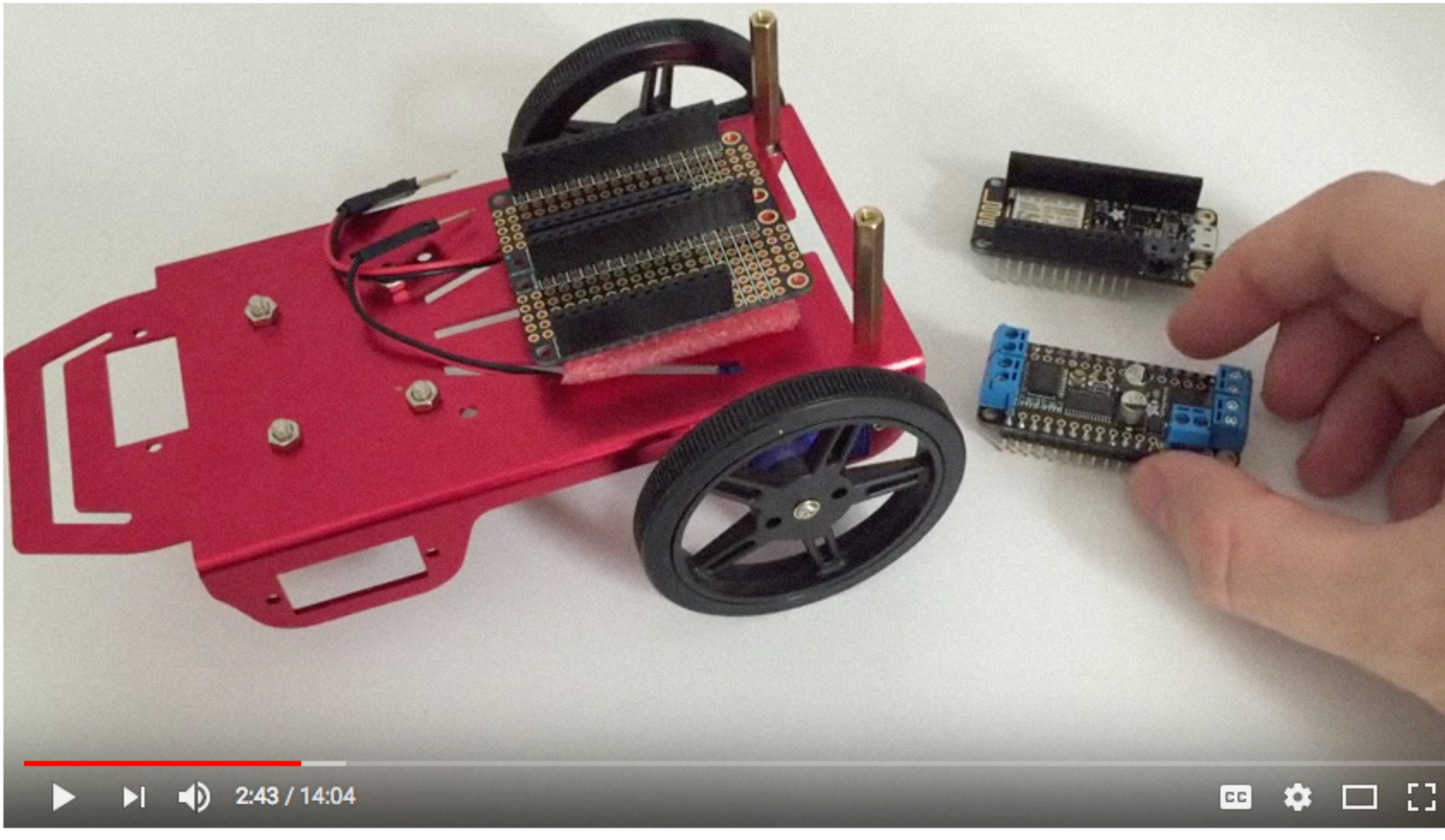

solder
soldering iron

stay if you want to solder!

otherwise see you on friday!

a few things to do some time…

- read some **books & tutorials**
- watch some **youtube videos**
- doing this a bit on the side goes a long way…



Build a WiFi Controlled Robot with the ESP8266

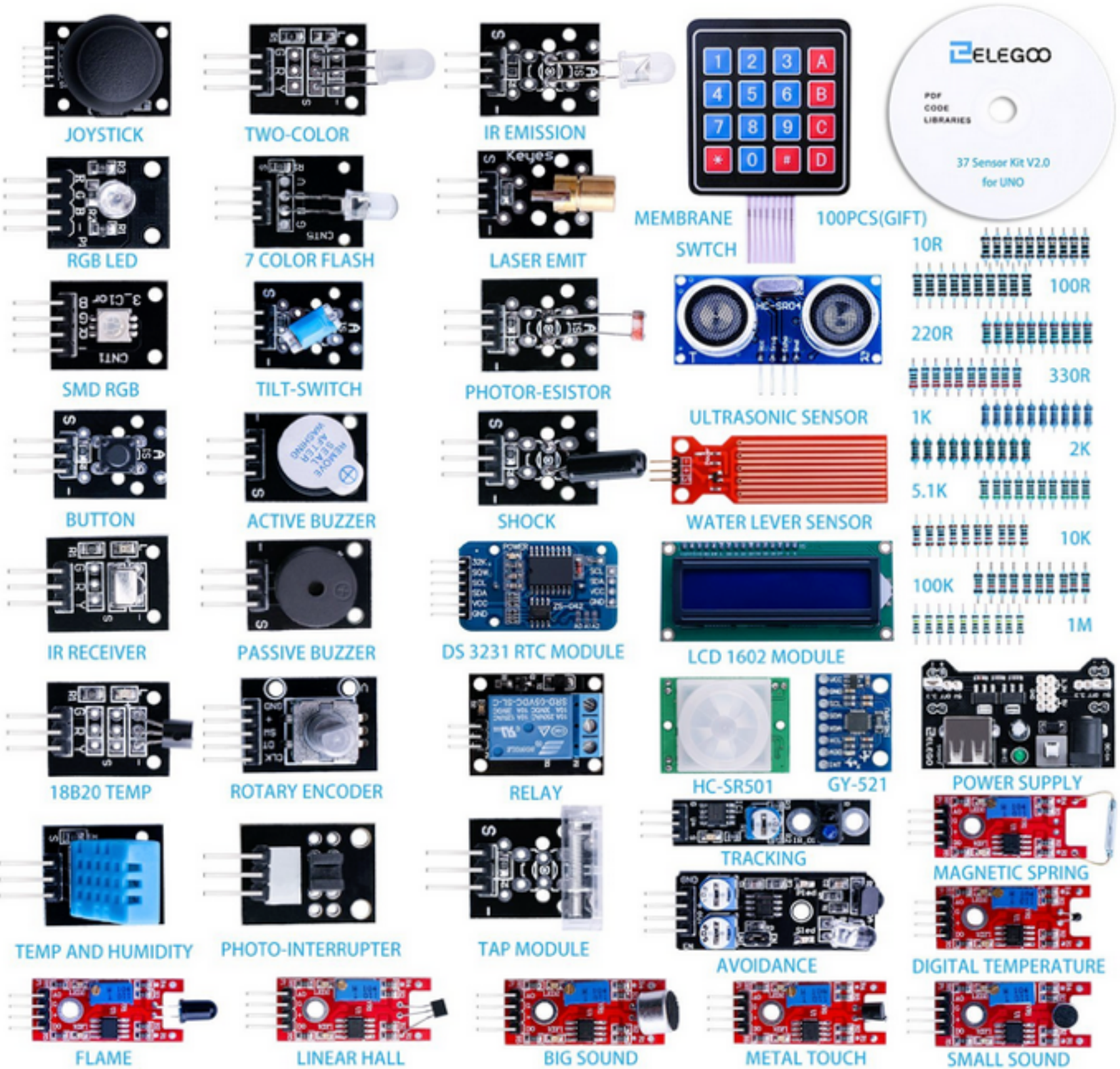
Elegoo

Elegoo Upgraded 37 in 1 Sensor Modules Kit with Tutorial for Arduino UNO R3 MEGA 2560 Nano 2016 new version

4.5 ▾ 320 customer reviews | 49 answered questions

Price: ~~$42.99~~
Sale: $27.98 ✓prime
You Save: $15.01 (35%)

- **play around with some sensors**



let’s solder & make this a real cable

- solder the male-to-make connectors on

<5 min>

let’s solder two LEDs together

- take two LEDs
- warm up the soldering iron
- use solder and connect them
- warm solder on LED to disconnect again

<5 min>

end.