



# Introduction to Sensors – Practical

Industry 4.0 with Human Touch, Technology course

By Fjodor van Slooten

**UNIVERSITY  
OF TWENTE.**

# CONTENT

## Introduction to Sensors - Practical

- Introduction to prototyping with Arduino
- Practical

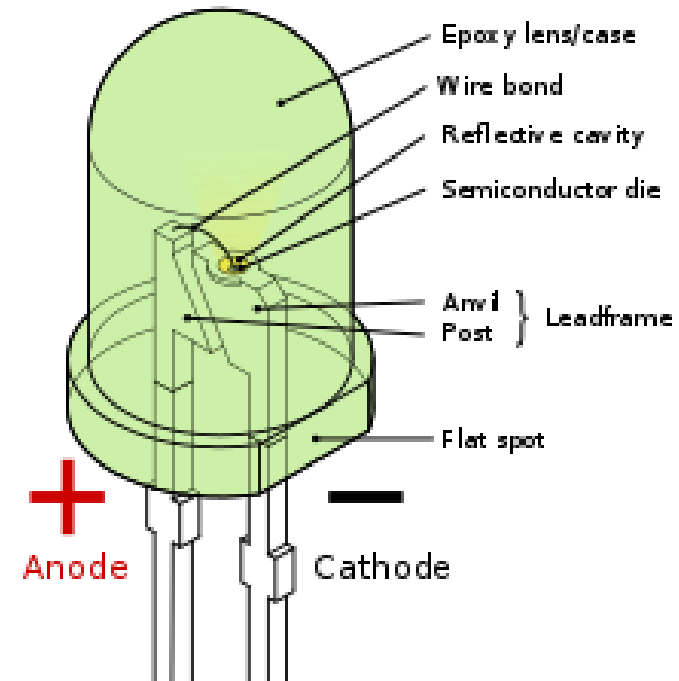
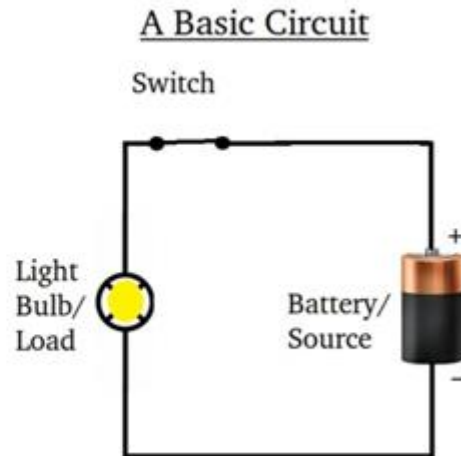
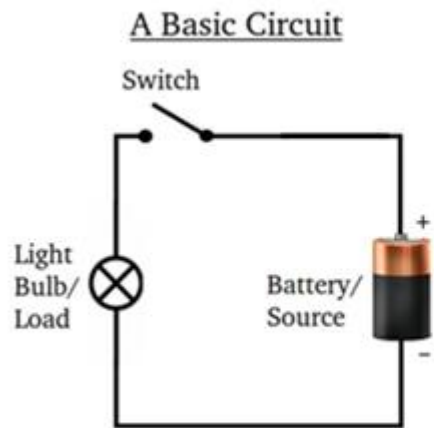
Contact: [f.vanslooten@utwente.nl](mailto:f.vanslooten@utwente.nl)

This presentation & tutorials available at:  
[vanslooten.com/i40](https://vanslooten.com/i40) or via Canvas



# Electronics 101

Current flows from + to – when a circuit is complete



LED

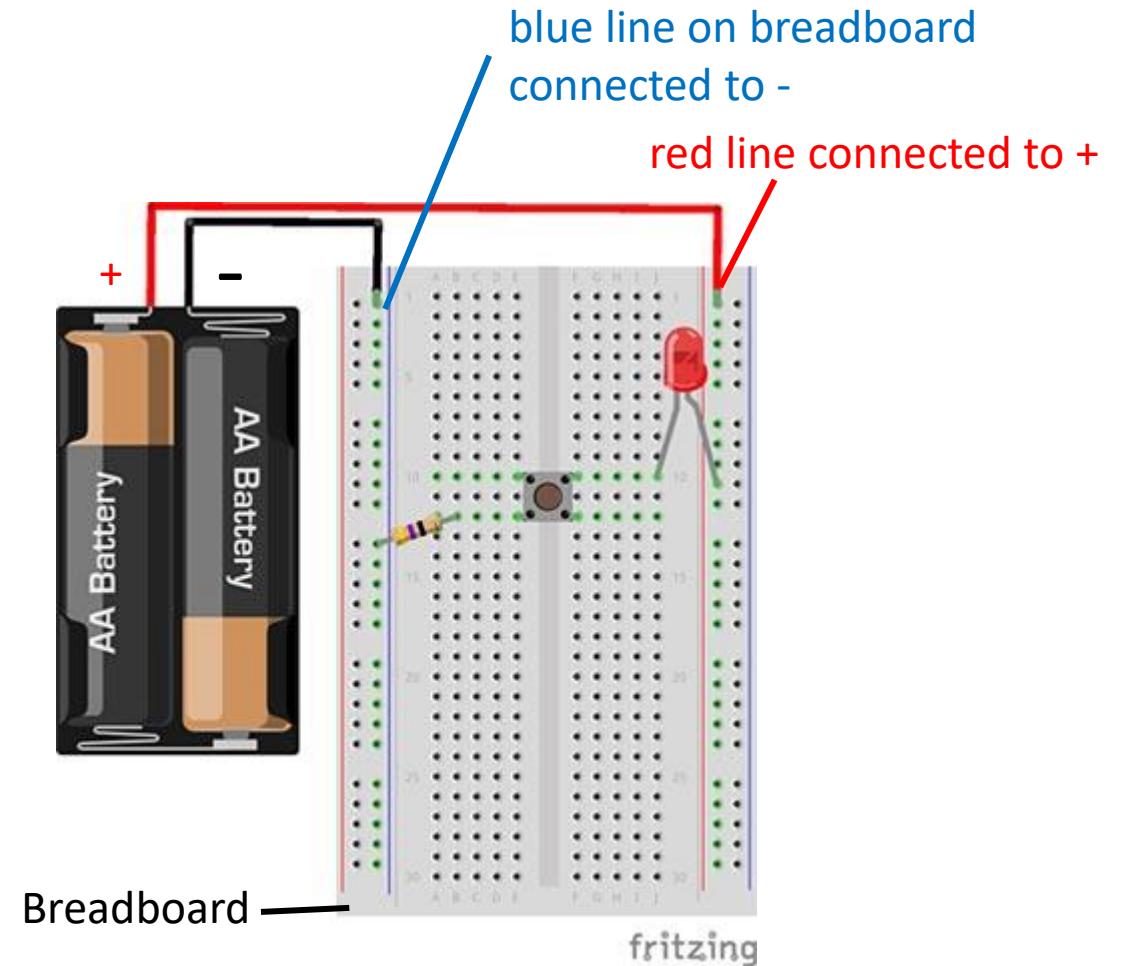
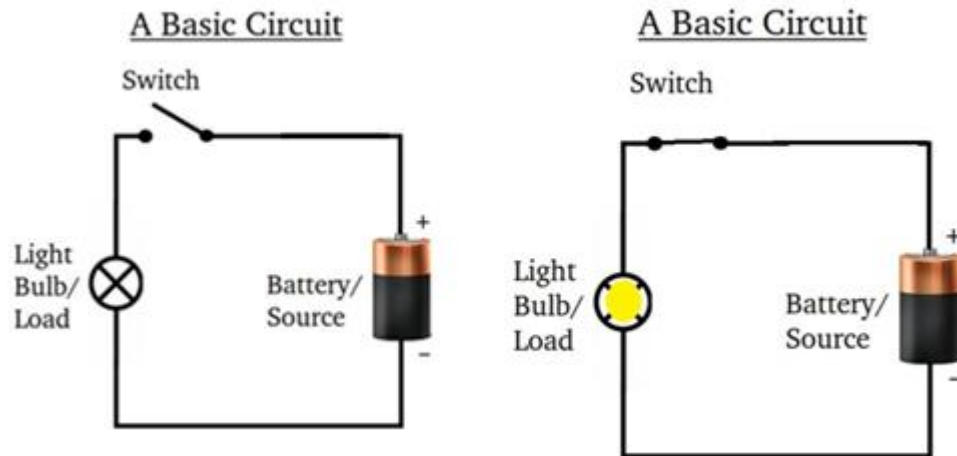
Breaks if too much current goes through.

We use a resistor to limit the current.



# Electronics 101

Current flows from + to – when a circuit is complete



LED

Breaks if too much current goes through.  
We use a resistor to limit the current.





# Electronics 101: Breadboard power

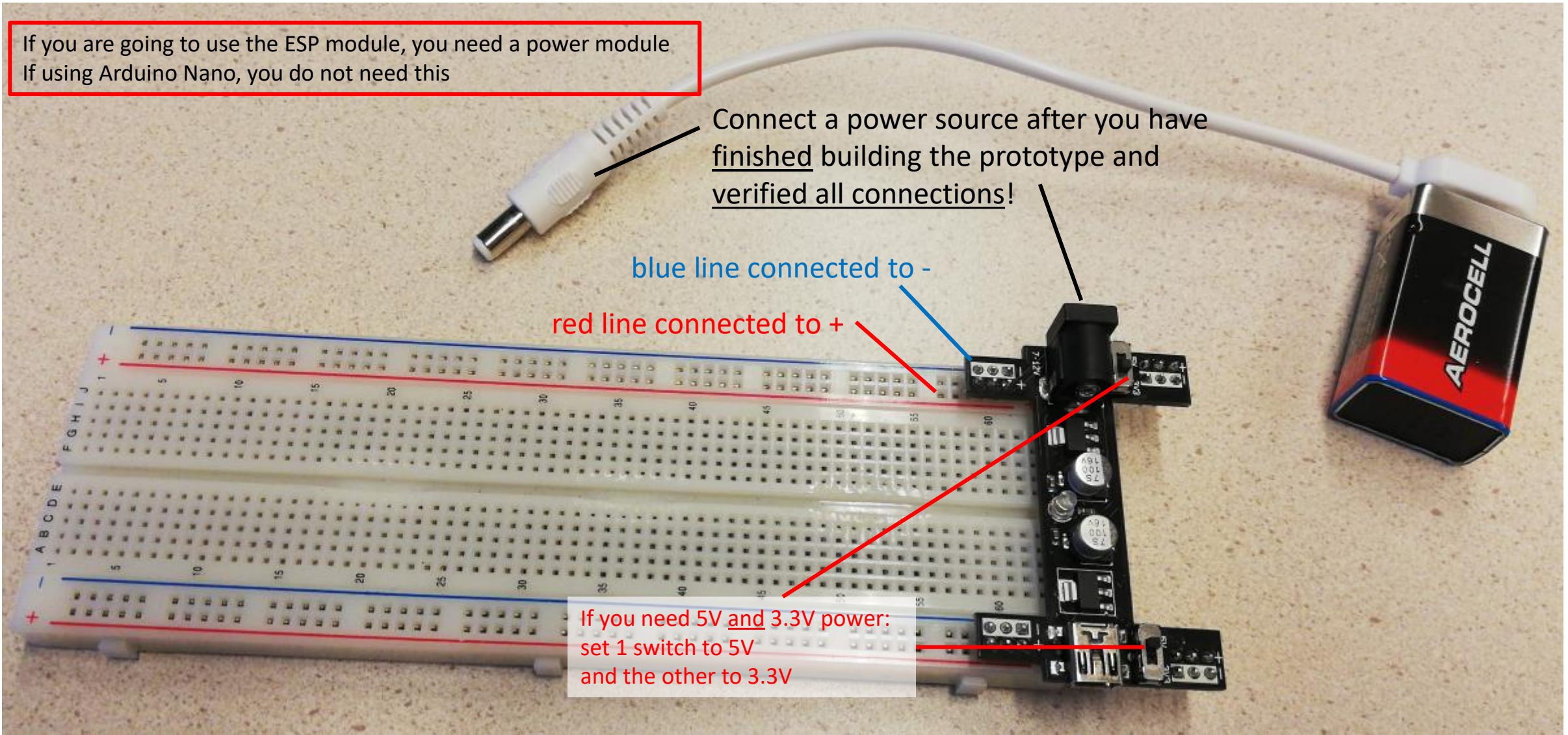
If you are going to use the ESP module, you need a power module  
If using Arduino Nano, you do not need this

Connect a power source after you have  
finished building the prototype and  
verified all connections!

blue line connected to -

red line connected to +

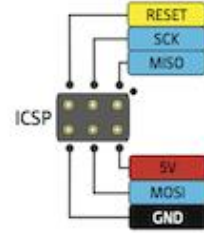
If you need 5V and 3.3V power:  
set 1 switch to 5V  
and the other to 3.3V



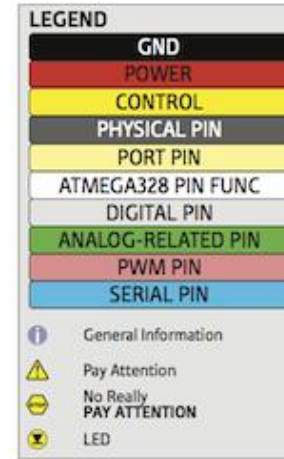
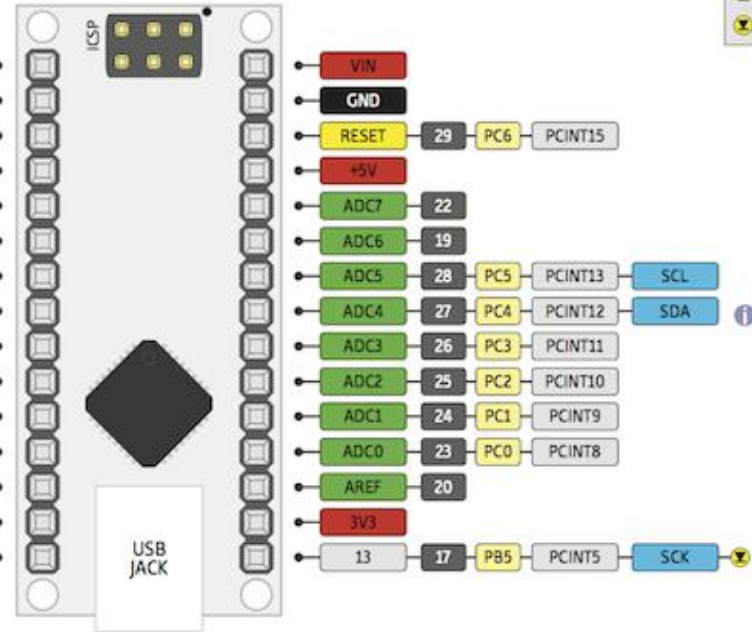
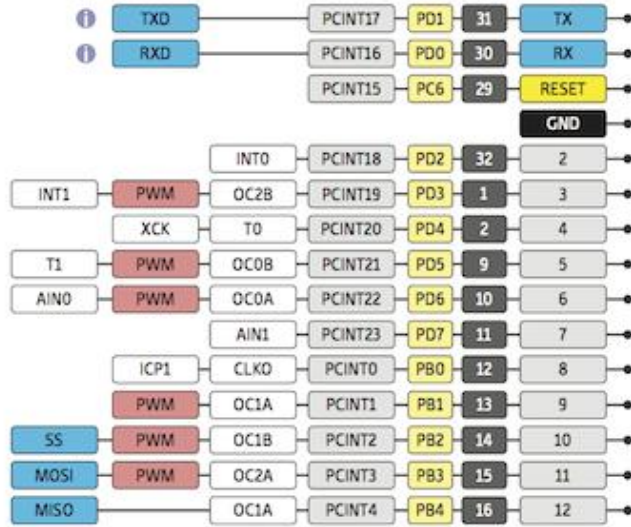


THE  
UNOFFICIAL  
**ARDUINO  
NANO**  
PINOUT DIAGRAM

- ⚠ Absolute max per pin 40mA  
recommended 20mA
- ⚡ Absolute max 200mA  
for entire package



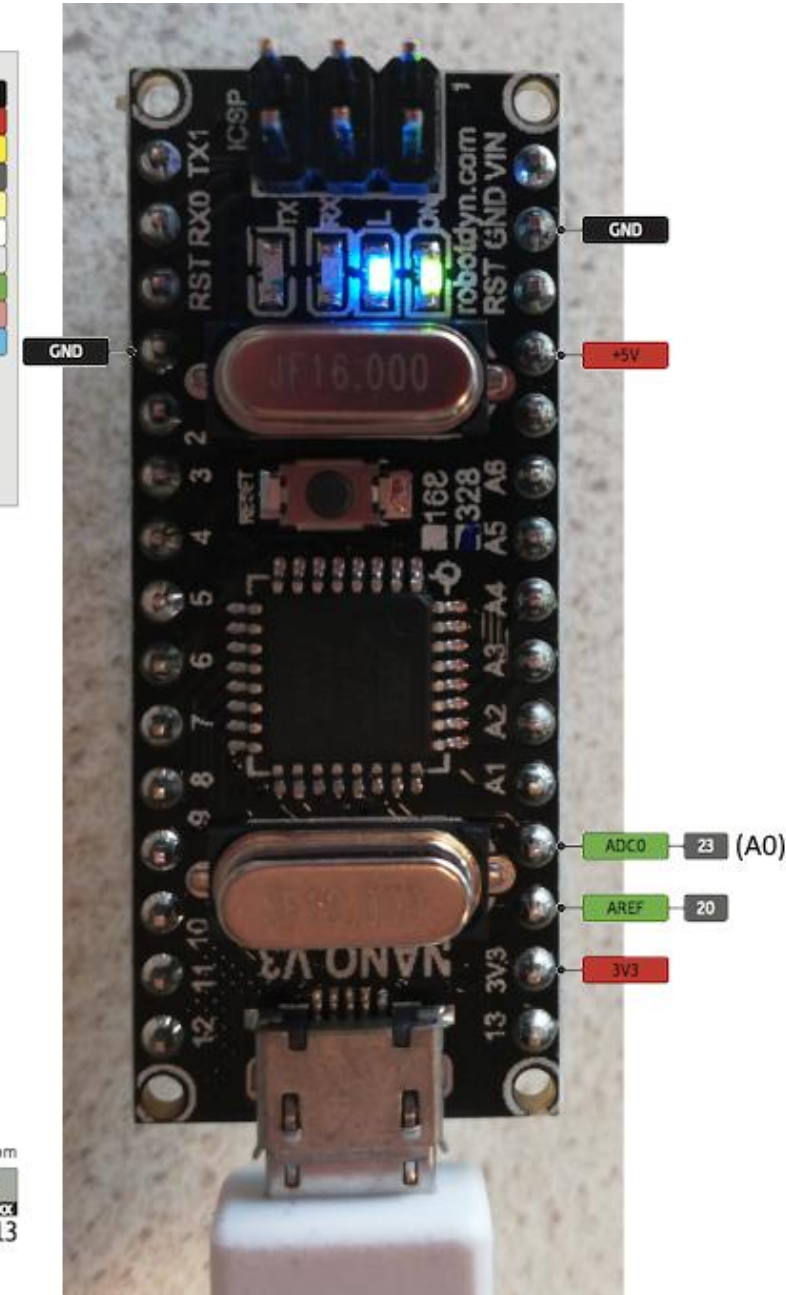
Connected to the ATmega  
and used for USB program  
and communicating with it



On version 2  
Analog Pins are reversed  
e.g. A0 ↔ A7, A7 ↔ A0

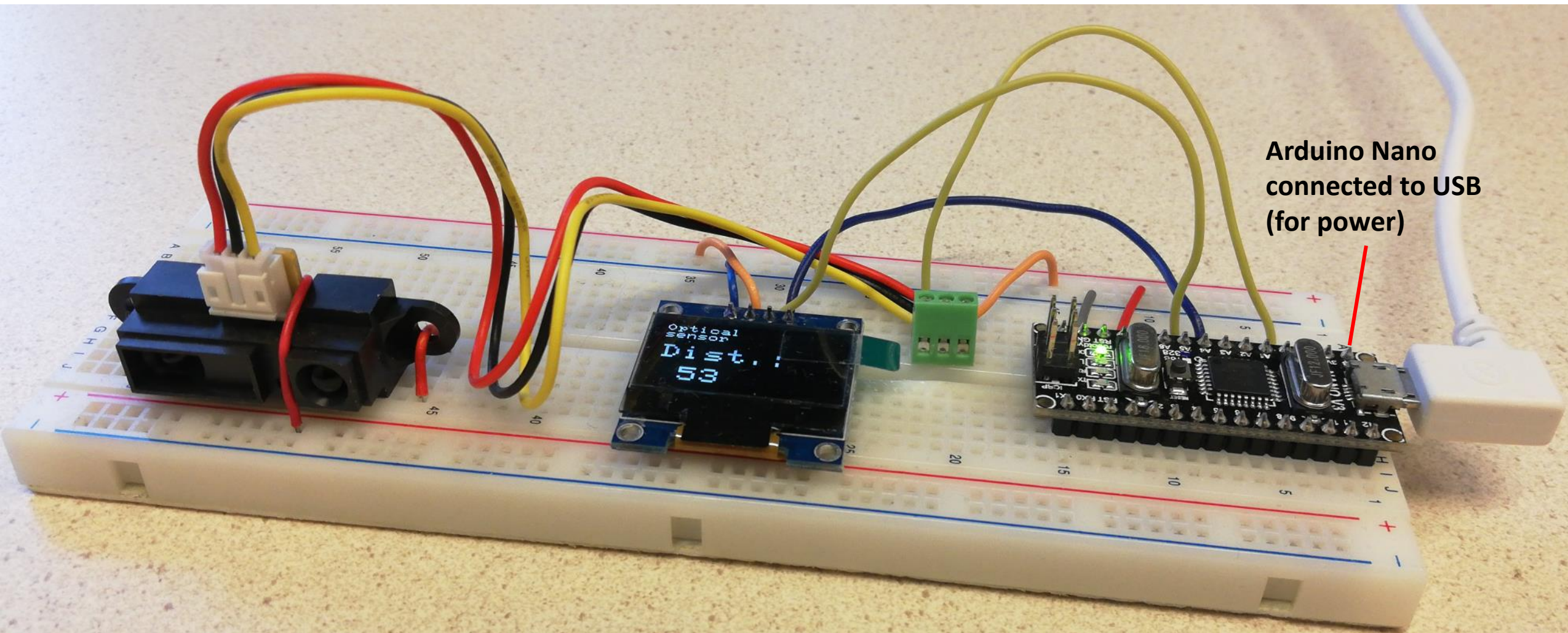


www.piggyback.com  
CC BY NC ND  
07 FEB 2013



This type of Arduino comes with 5V and 3.3V power pins, so if you connect it to USB, you can use these (no power module needed), you may also use this Arduino as a power module if you do not have one at hand ;-)

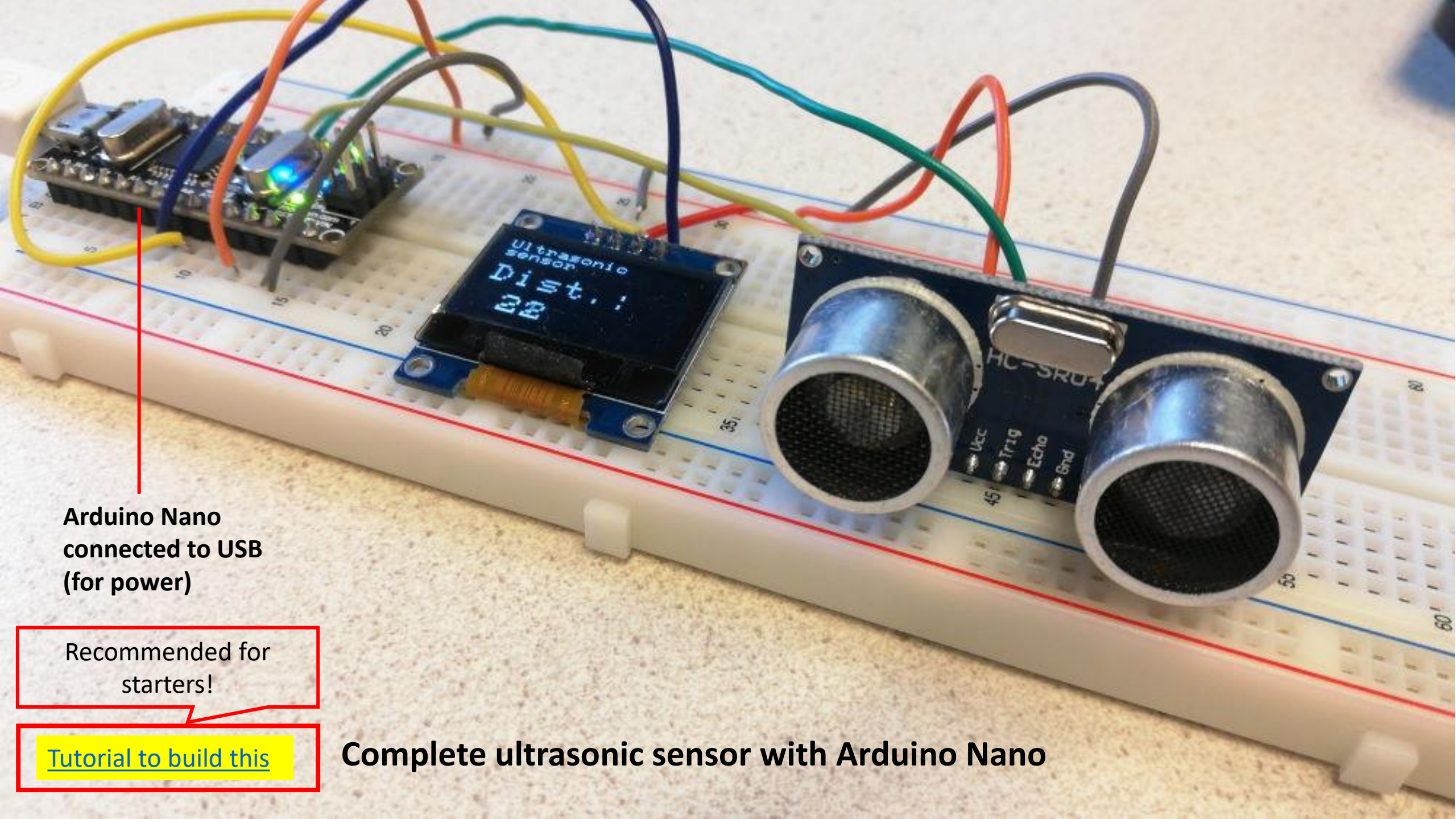




[Tutorial to build this](#)

## Complete optical sensor with Arduino Nano





Arduino Nano  
connected to USB  
(for power)

Recommended for  
starters!

[Tutorial to build this](#)

Complete ultrasonic sensor with Arduino Nano



[Tutorial to build this](#)

connection to GND

ESP module

Connect to battery,  
or connect usb cable at other end

Ultrasonic sensor MUST be  
connected to 5V

set switch to 5V

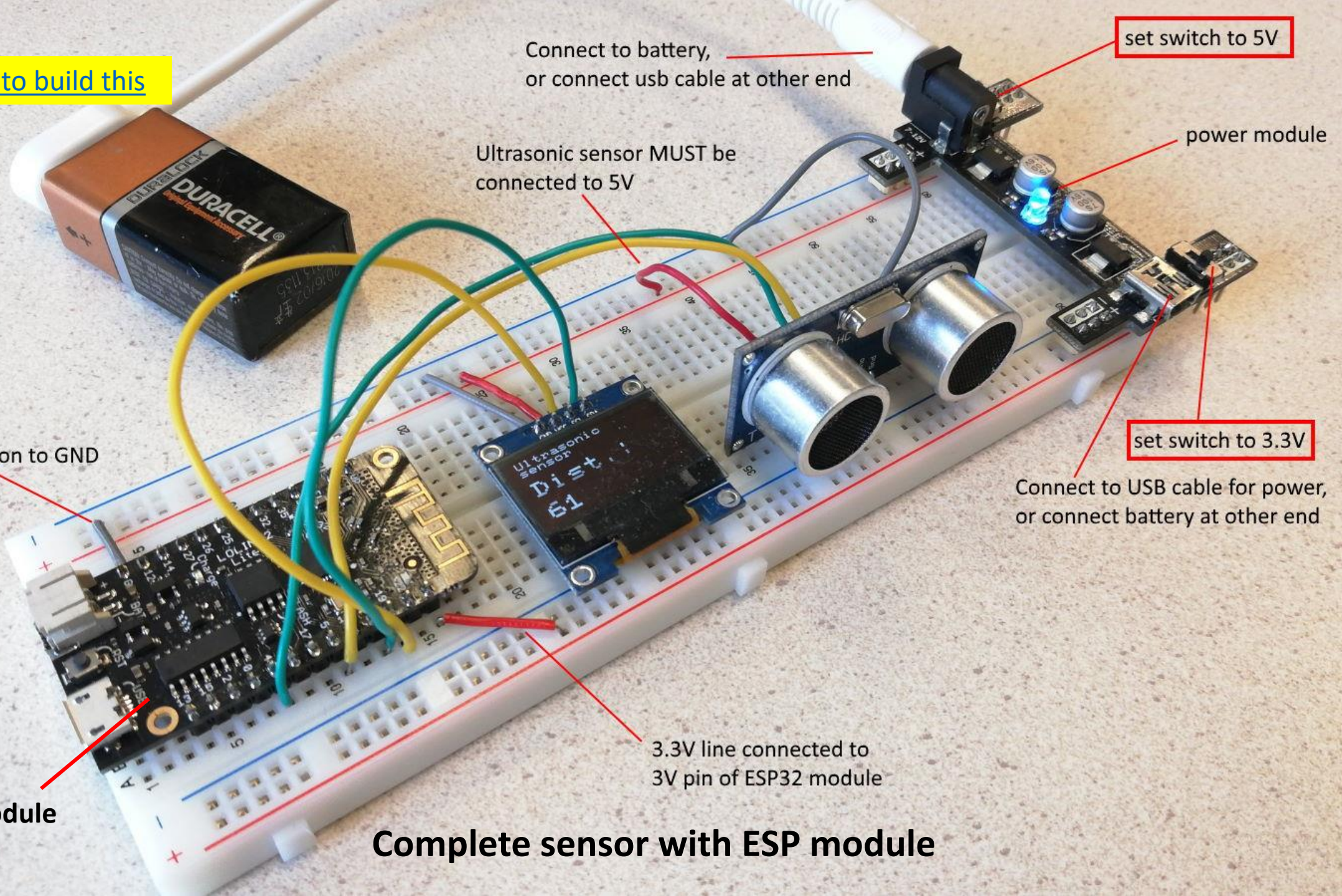
power module

set switch to 3.3V

Connect to USB cable for power,  
or connect battery at other end

3.3V line connected to  
3V pin of ESP32 module

**Complete sensor with ESP module**





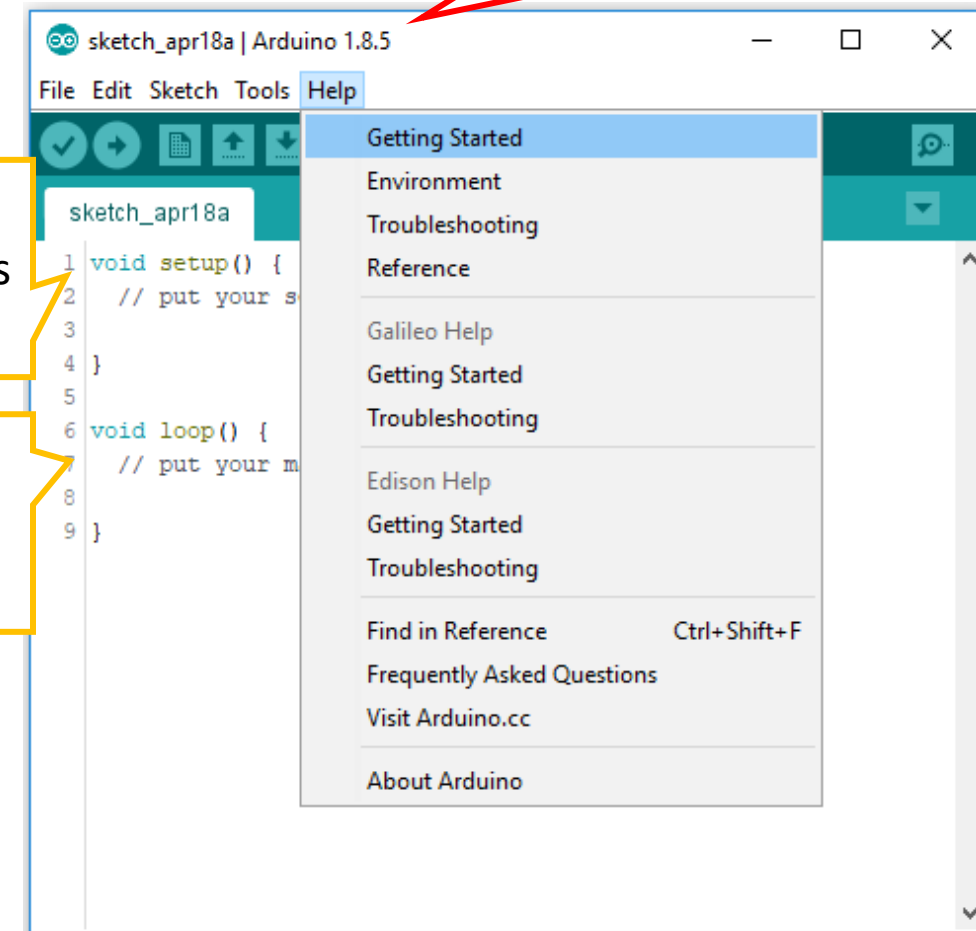
# Arduino programming

- Arduino program also called: **sketch**
- Language: C++ (similar to Java)
- Download & install Arduino Desktop IDE @ [arduino.cc/en/Guide](https://arduino.cc/en/Guide)
- Start with Examples: [arduino.cc/en/Tutorial/BuiltInExamples](https://arduino.cc/en/Tutorial/BuiltInExamples)
- ... or use examples from practical

**setup():** start of program, runs once

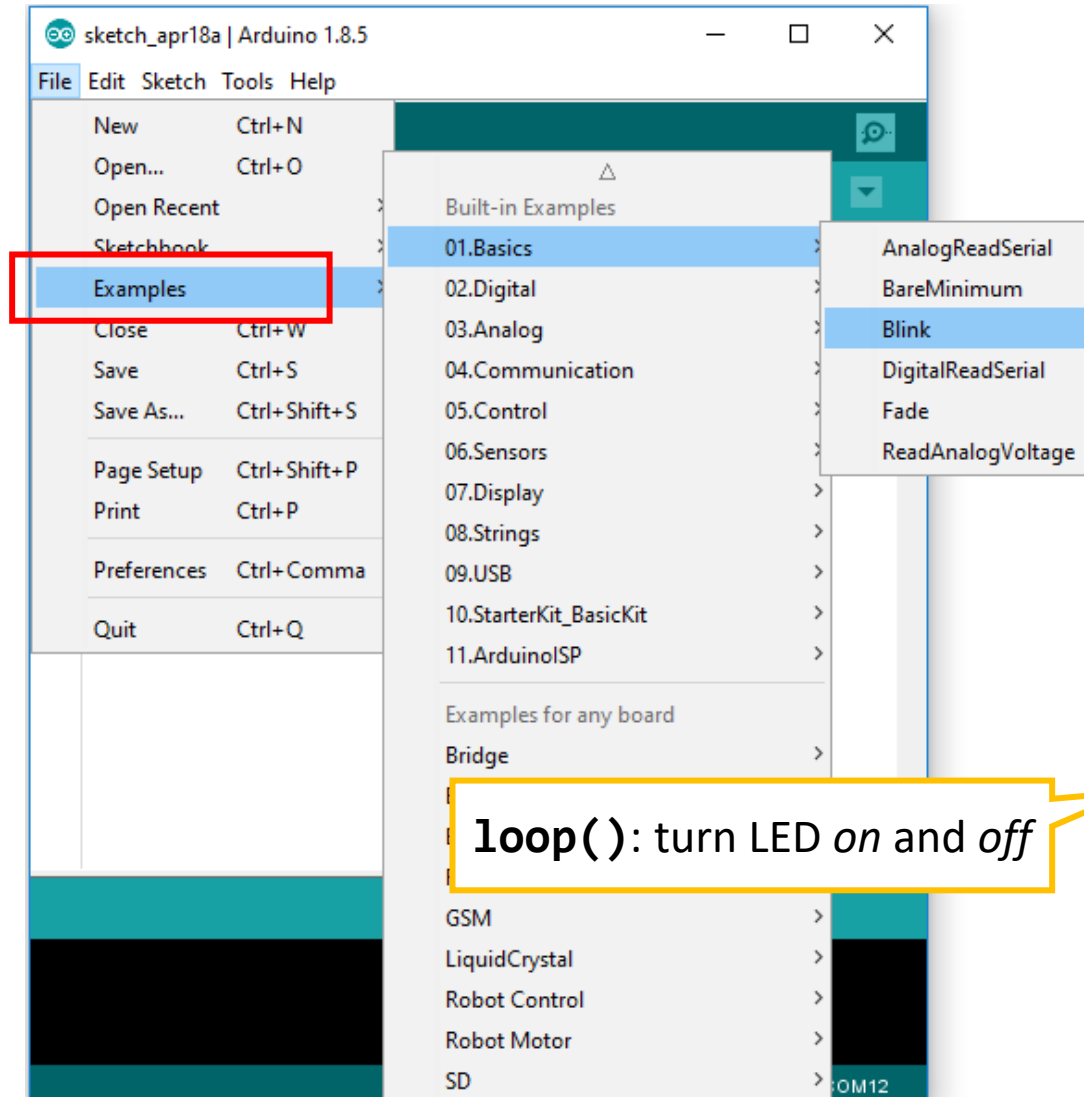
**loop():** runs continuously after setup()

This is 1.x version, latest is 2.x

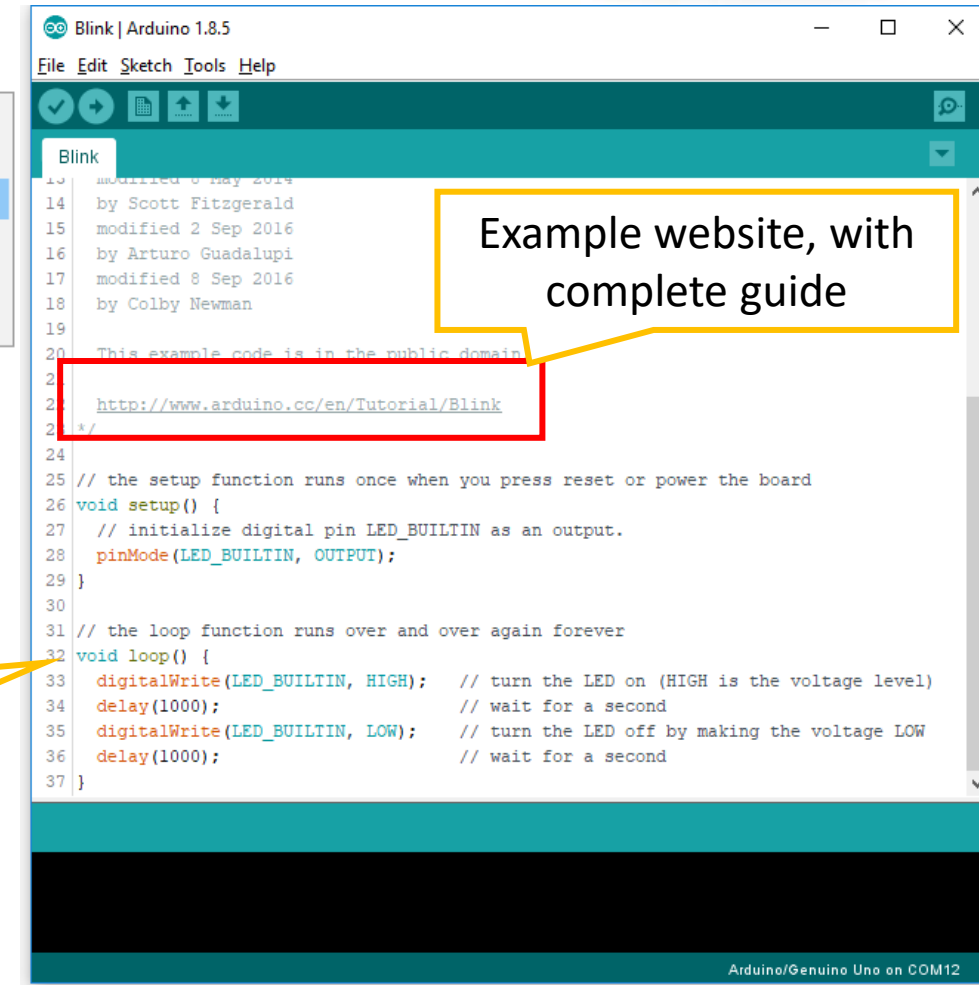




# Learn from examples



LED\_BUILTIN is the LED on the board

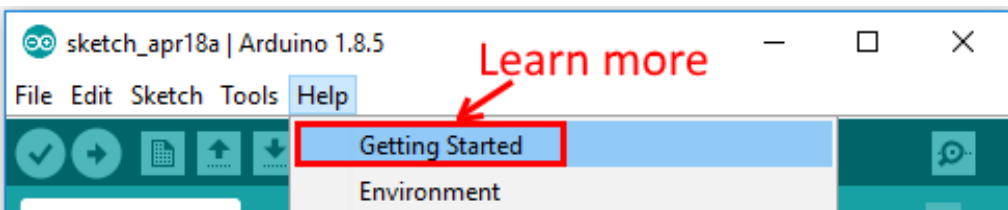
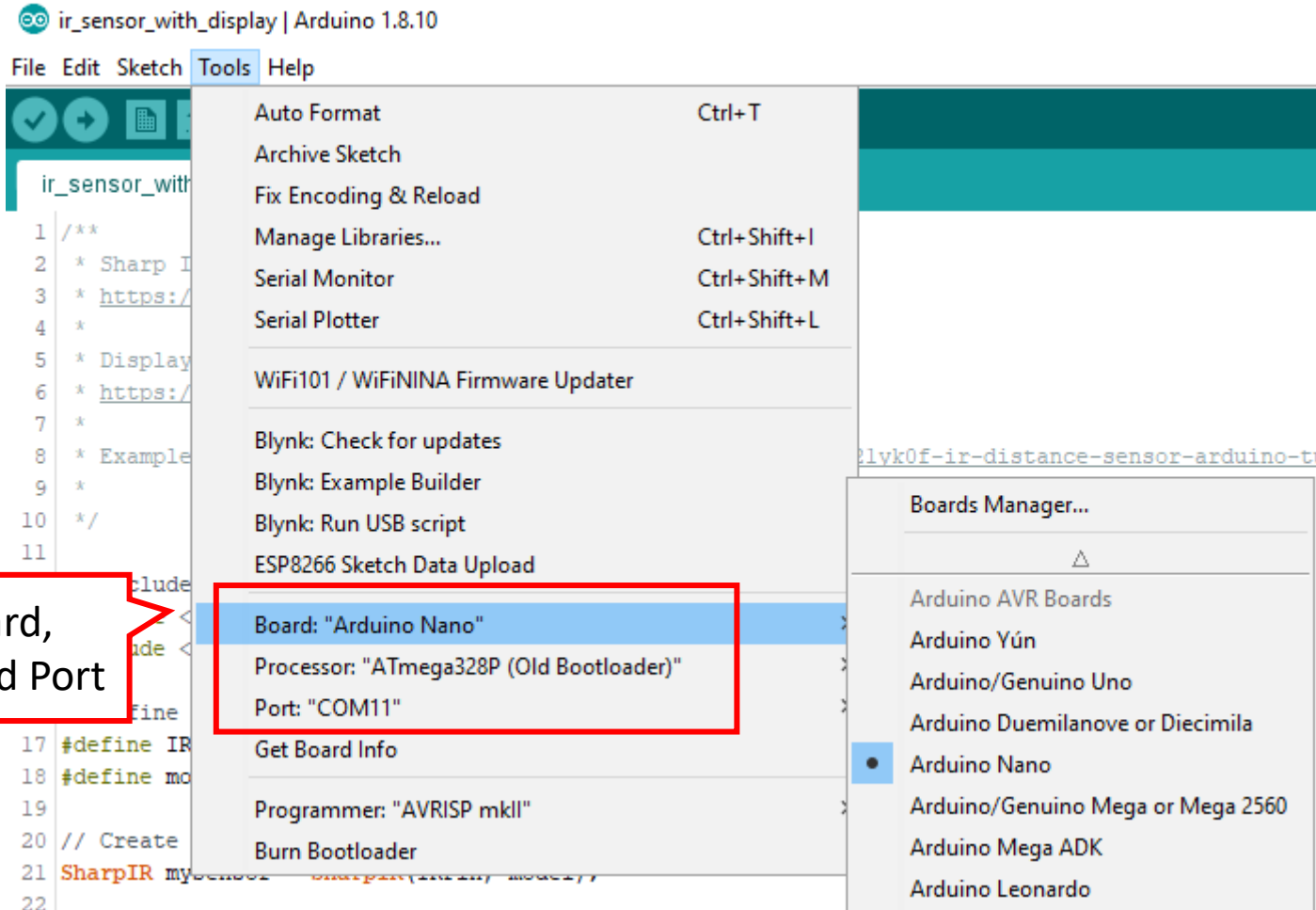


# Run a program

Connect USB  
cable first!

Click Upload

Select Board,  
Processor and Port





# Programming

Initialize LED\_BUILTIN pin as an output pin with:

**pinMode(LED\_BUILTIN, OUTPUT);**

In the main loop, you turn the LED on with:

**digitalWrite(LED\_BUILTIN, HIGH);**

```
Blink | Arduino 1.8.5
File Edit Sketch Tools Help

[Icons: Checkmark, Run, Serial Monitor, Upload] Upload

Blink
16 by Arturo Guadalupi
17 modified 8 Sep 2016
18 by Colby Newman
19
20 This example code is in the public domain.
21
22 http://www.arduino.cc/en/Tutorial/Blink
23 */
24
25 // the setup function runs once when you press reset or power
26 void setup() {
27   // initialize digital pin LED_BUILTIN as an output.
28   pinMode(LED_BUILTIN, OUTPUT);
29 }
30
31 // the loop function runs over and over again forever
32 void loop() {
33   digitalWrite(LED_BUILTIN, HIGH); // turn the LED on (HIGH :
34   delay(1000); // wait for a second
35   digitalWrite(LED_BUILTIN, LOW); // turn the LED off by mal
36   delay(1000); // wait for a second
37 }
```

# Practical session

Get a 'sense' 🧐 of what is involved in selecting, implementing and testing sensors

Build a sensor, test it, do some measurements (determine accuracy, validity, reliability)

Evaluate/reflect

Apply what you learned to project assignment:

- What kind of questions can be formulated regarding sensors/sensing in the quick scan?
- What can be used to improve the “Educational quick scan Industry 4.0”? (e.g. the Measurement questions)
- What can be used from this lecture/practical to create and advise on how to achieve a greater industry 4.0 maturity (future state)?

[Goto vanslooten.com/i40/sensor-practical to do the practical](https://vanslooten.com/i40/sensor-practical)





# QUESTIONS?

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f.vanslooten@utwente.nl