waag society

institute for art, science and technology

# BioHack Academy
# Incubator Design

Picture by Bas Uterwijk

# Why we need an incubator

- Microbes like a certain temperature
- Temperature dependent:
  - Enzyme reactions
  - DNA interactions
  - Cell state

Pixabay - CC0

# Industry standard

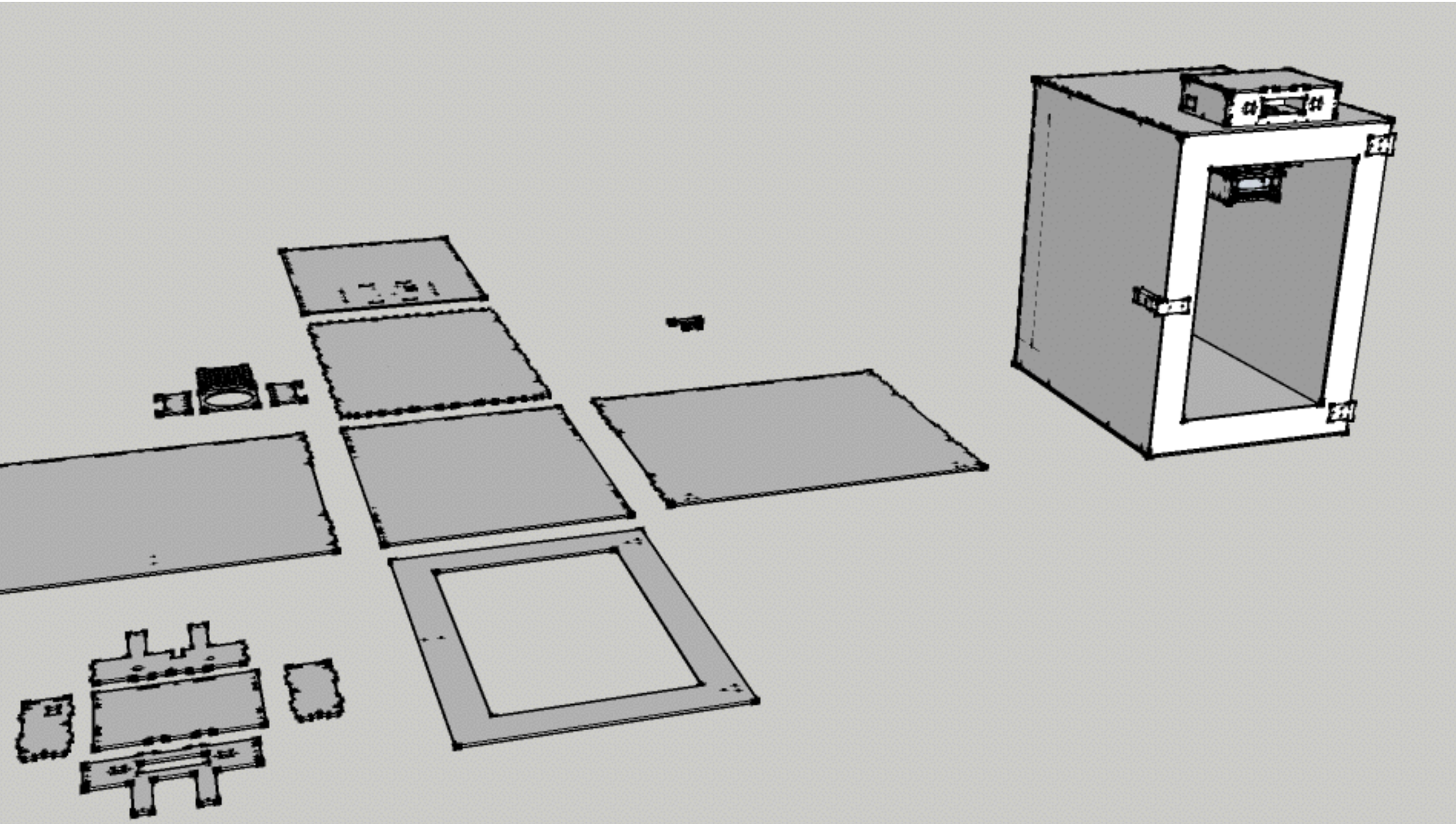

# Function

- Heat isolated enclosed cabinet, with see-through window
- Heat source
- Temperature controller
- Temperature indicator
- User interface to set temperature

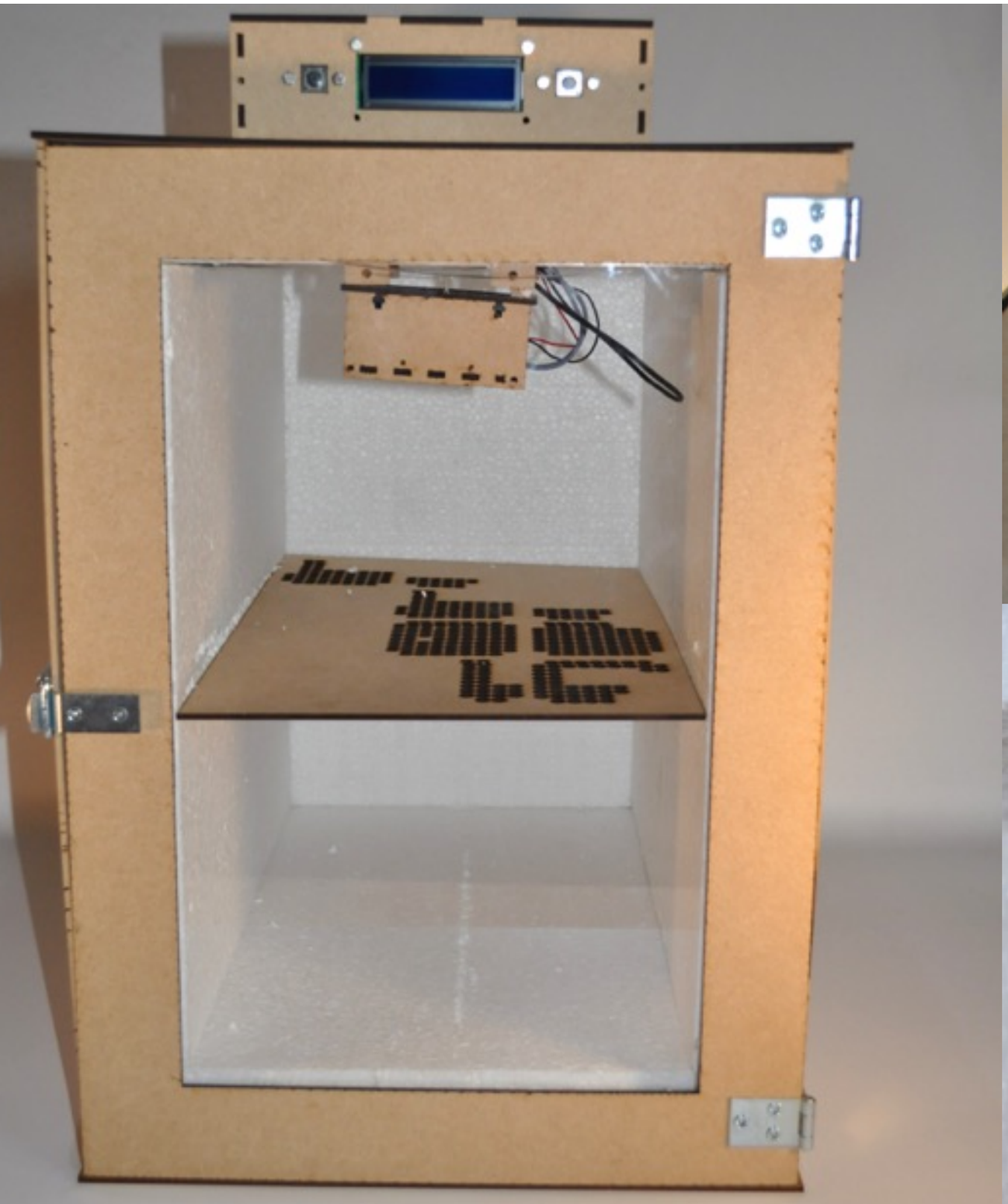
Design constrains:

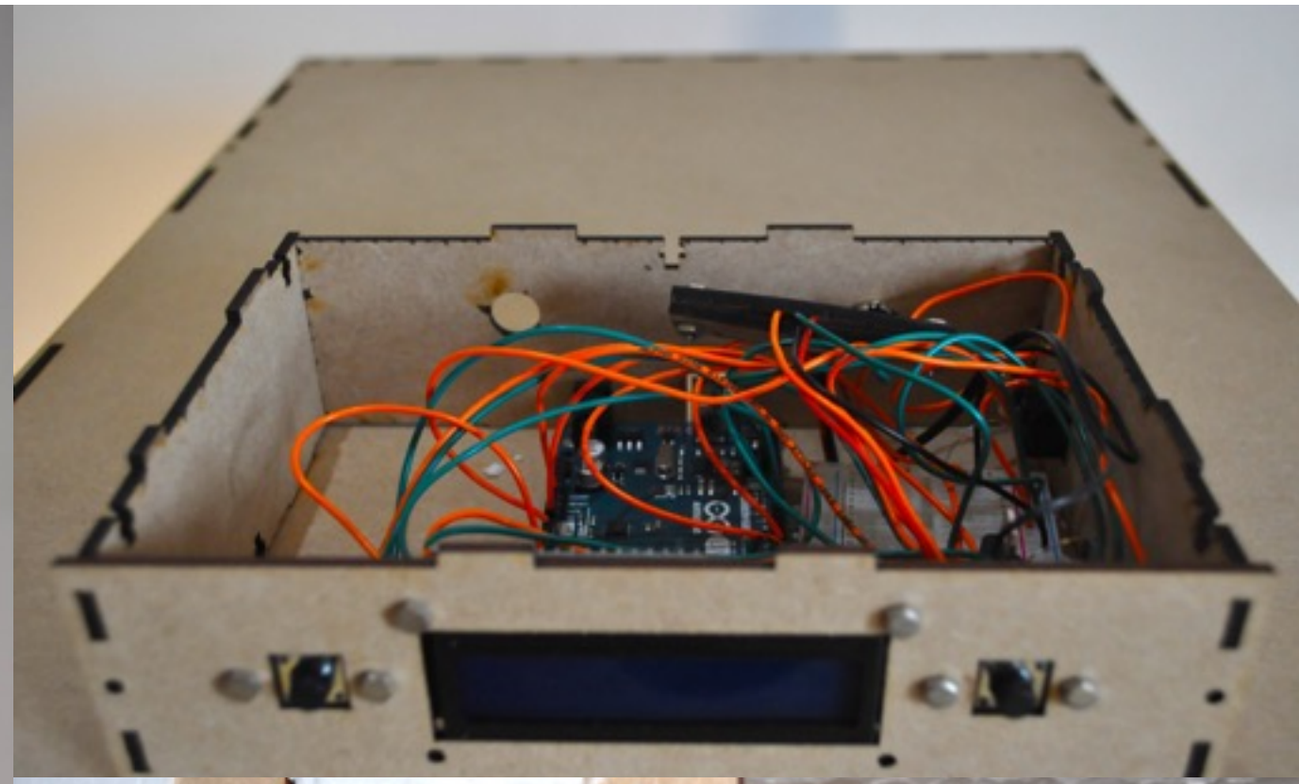
- 9 cm petri dishes

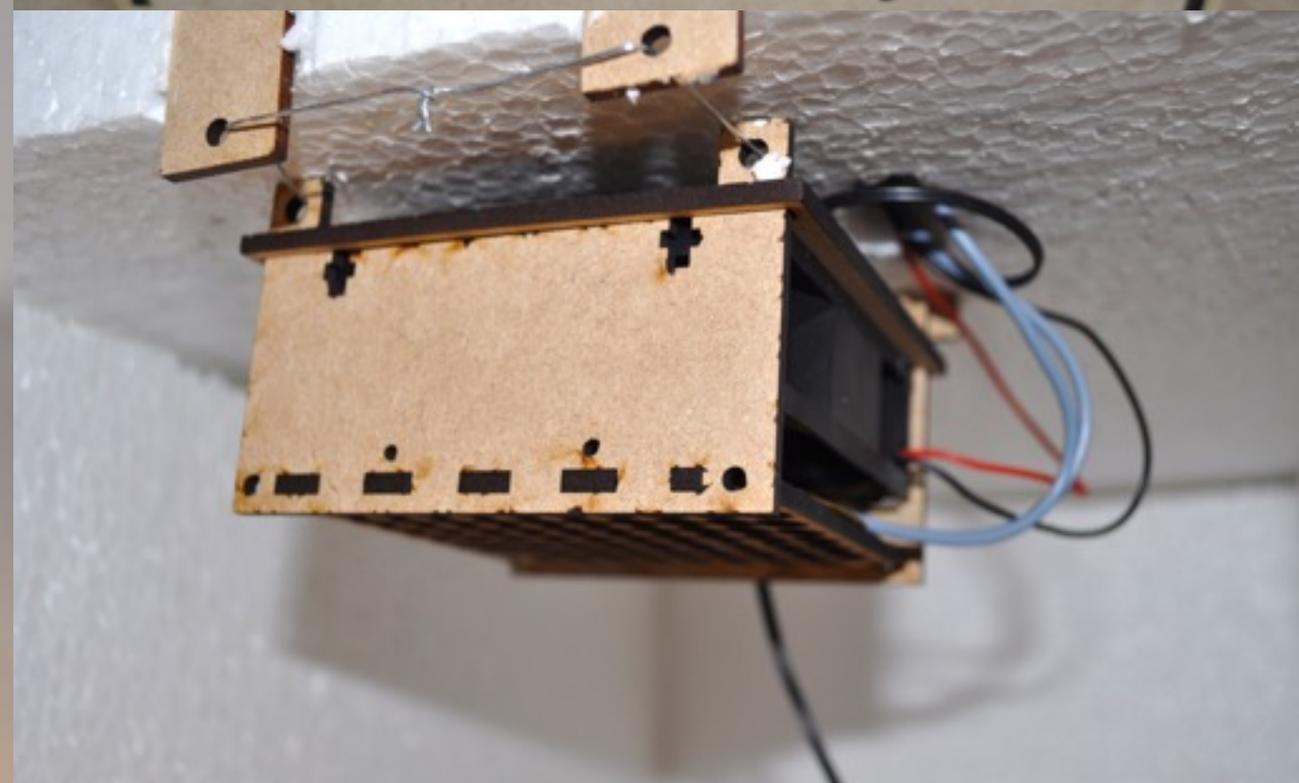
# Biohack Academy 2 Incubator



# BioHack Academy II Incubator





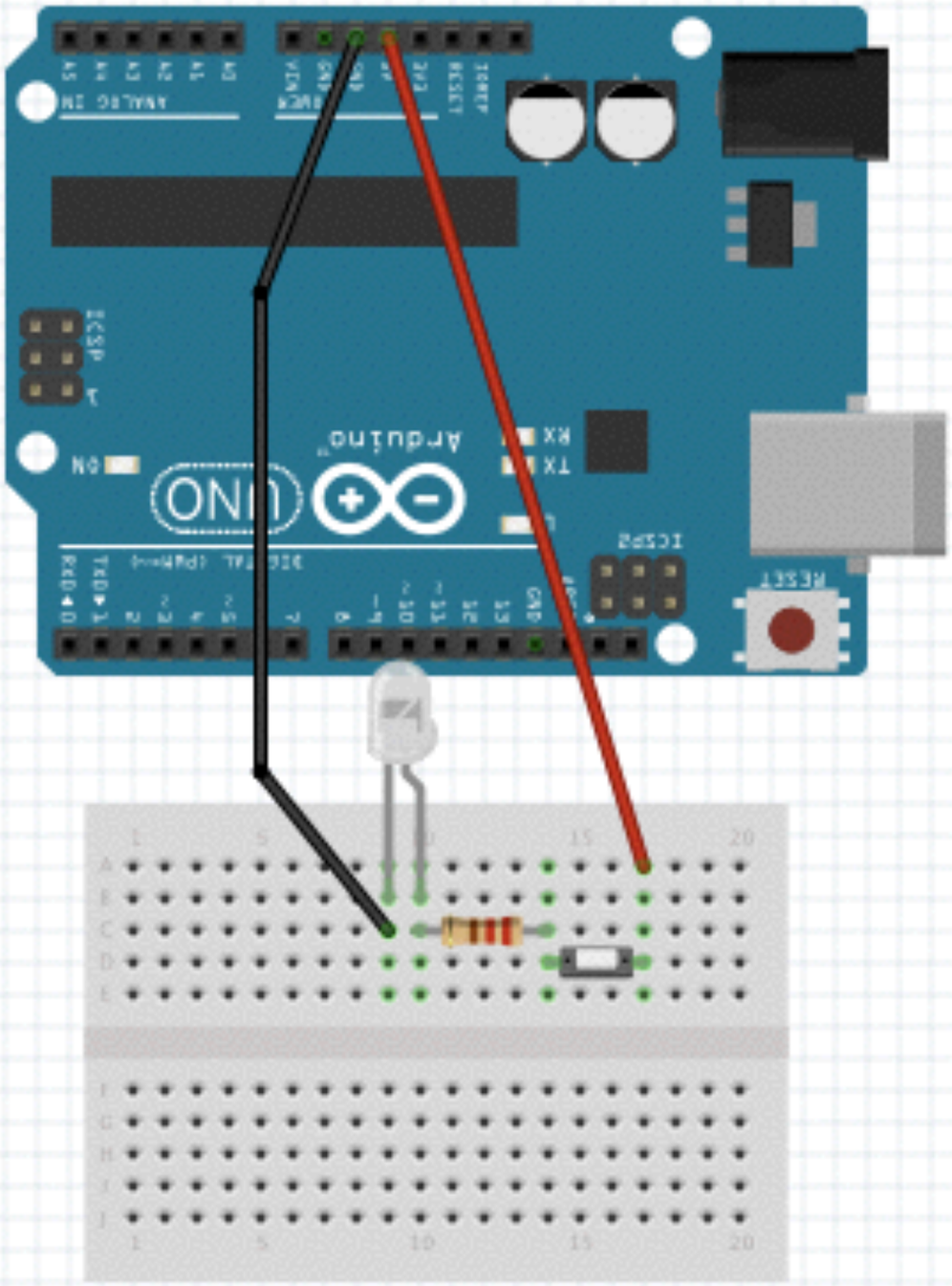


# Bill of Materials

| No | Amount | Description | Supplier NL | Cost |
|---|---|---|---|---|
| 1 | 4 | 3mm MDF 95 x 45 cm | Local wood store, like Houthandel Schmidt | 5.00 |
| 2 | 1 | Expanded polystyrene (EPS) | Praxis | 7.99 |
| 3 | 1 | 3mm Acrylic sheet 27 x 41 cm | Plexiglas.nl | 3.50 |
| 4 | 1 | 12V 80 mm Axial Fan | EOO, Farnell | 8.99 |
| 5 | 1 | Power switch | iPrototype | 0.95 |
| 6 | 1 | Water proof temperature sensor (*1) | HobbyElectronica, iPrototype | 2.95 |
| 7 | 1 | I2C LCD display | iPrototype, (HobbyElectronica + HobbyElectronica) | 16.95 |
| 8 | 2 | MOSFET | Farnell, EOO | 0.98 |
| 9 | 4 | 10K resistor | Farnell, EOO | 0.06 |
| 10 | 1 | Diode | iPrototype, EOO | 0.19 |
| 11 | 2 | Button | iPrototype | 0.55 |
| 12 | 1 | White LED | iPrototype, EOO | 0.52 |
| 13 | 1 | 220 Ohm resistor | iPrototype, EOO | 0.45 |
| 14 | 1 | 7.5 W power supply | iPrototype, EOO | 13.95 |
| 15 | 1 | Jack Adapter | EOO | 0.85 |
| 16 | 1 | Heating foil | Conrad | 20.68 |

# Powering an LED

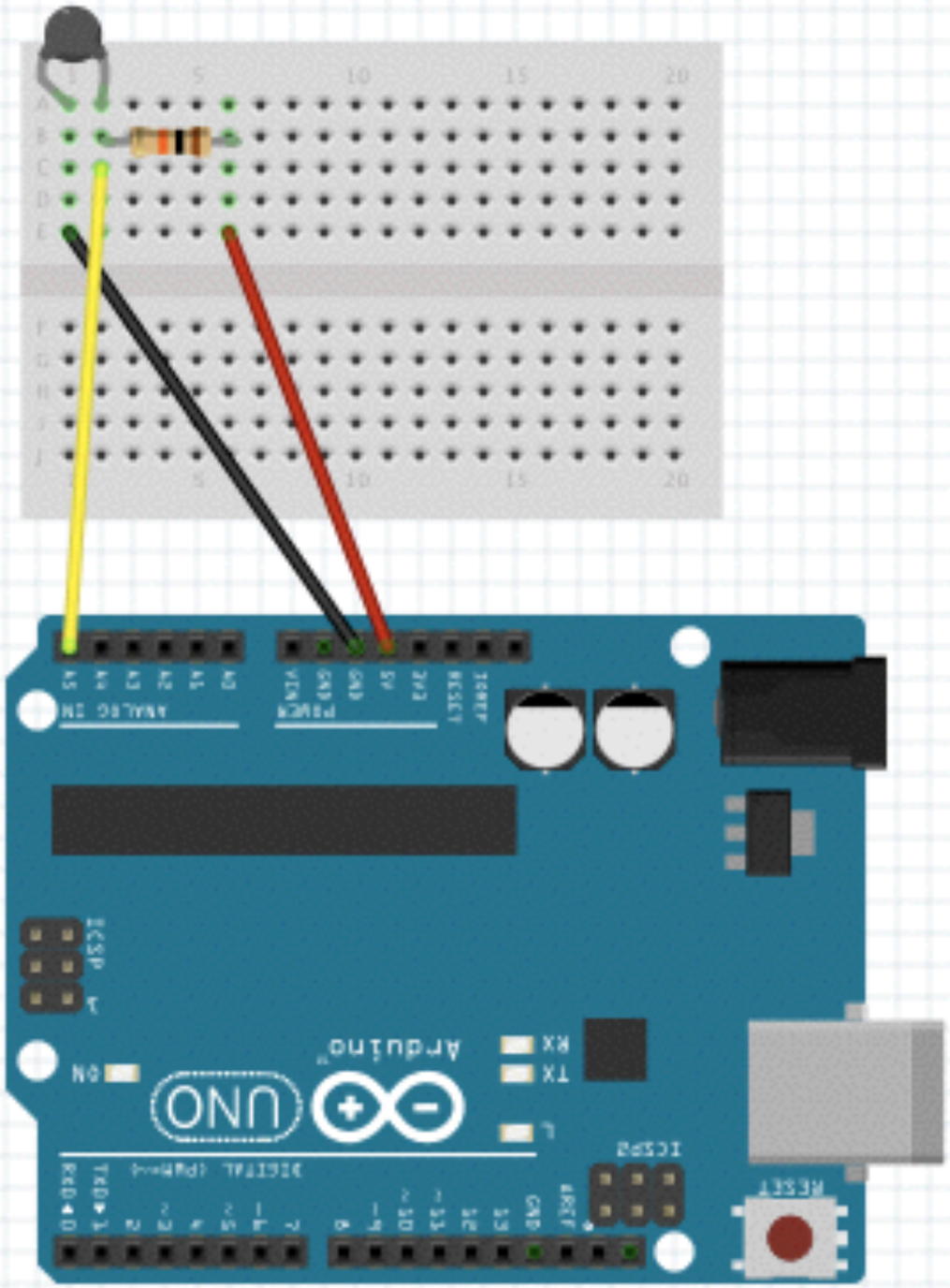
# LED circuit



# Sensing the temperature

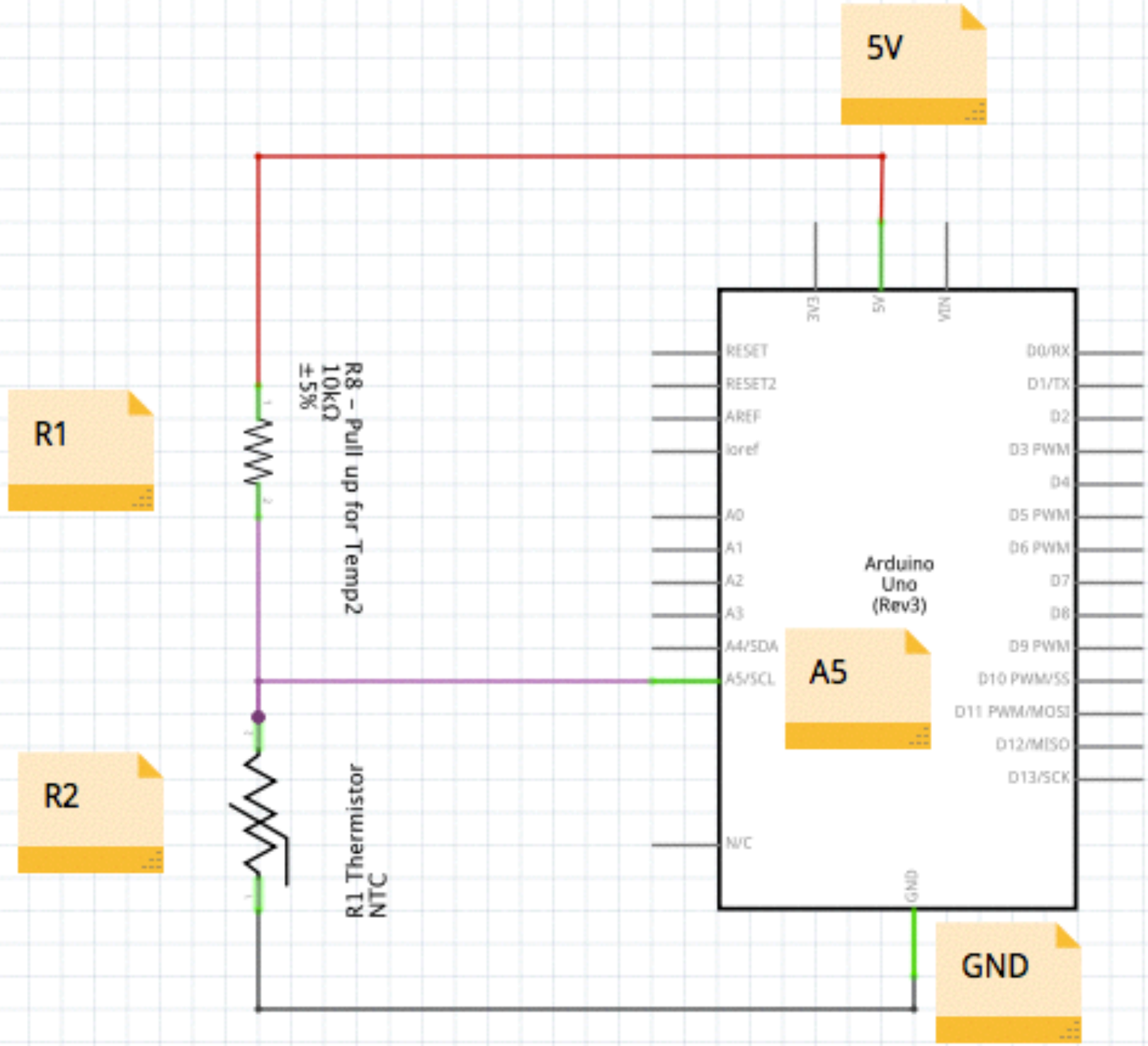
- 10K thermistor

# Sensing the temperature



# Schematic

$$Vout = Vin\left(\frac{R2}{R1+R2}\right)$$



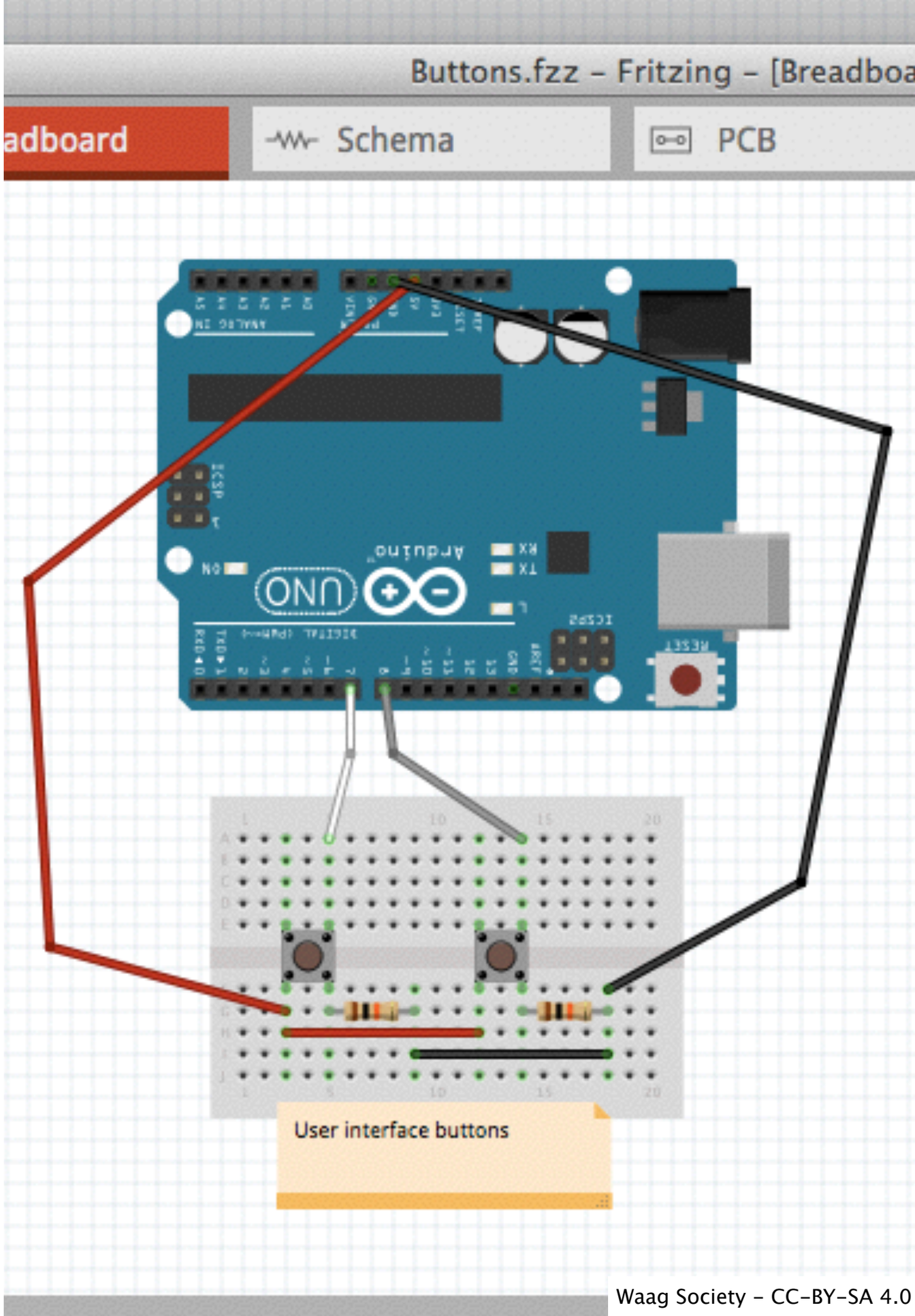
# Selecting a heat sour

- Lamp
  - Heat as a by product
- Microwave
  - Needs liquid to heat
- Infrared
  - 100W infrared
- Power resistor

# Push buttons

## Pull down resistors

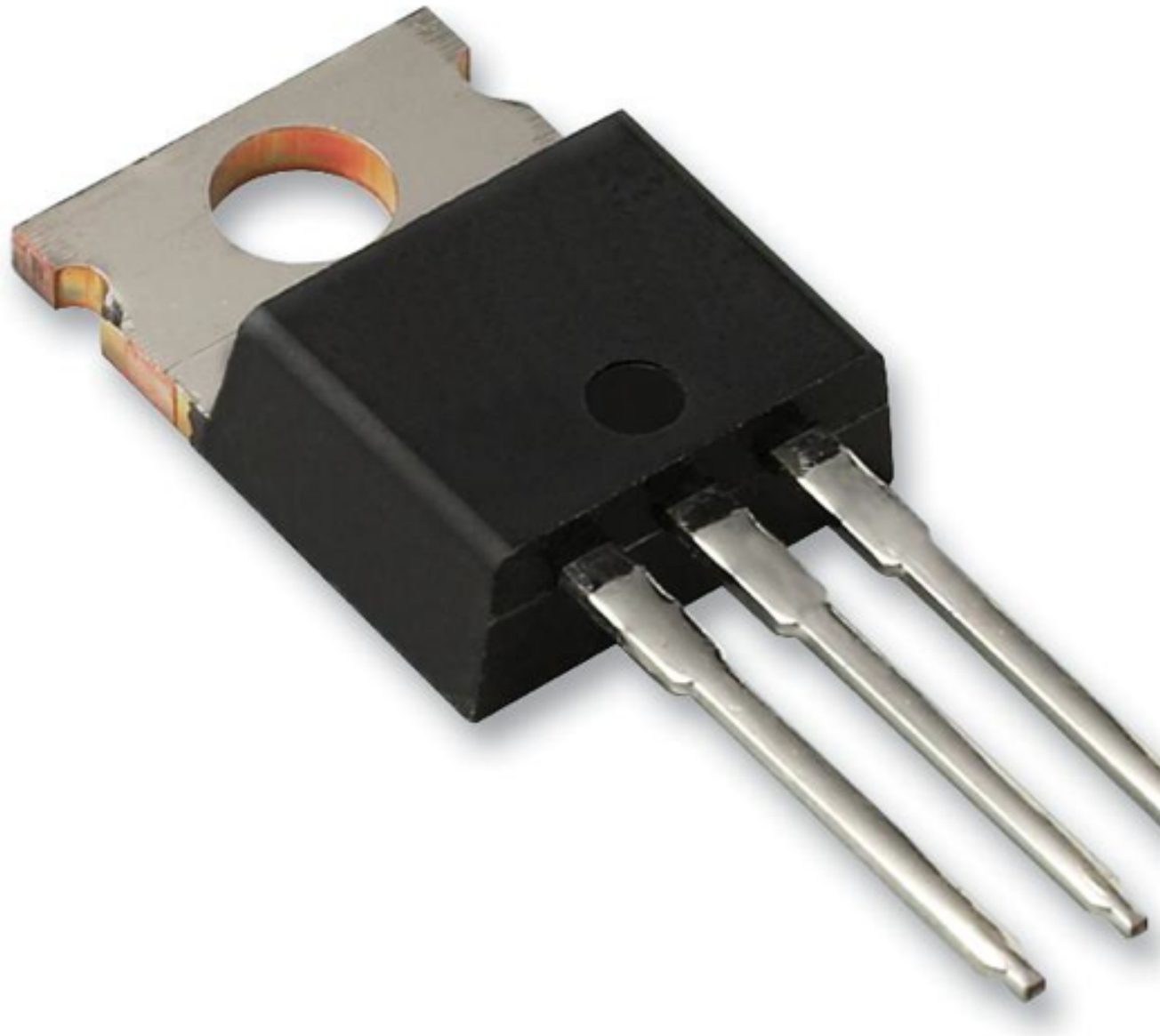
- 10 K Ohm



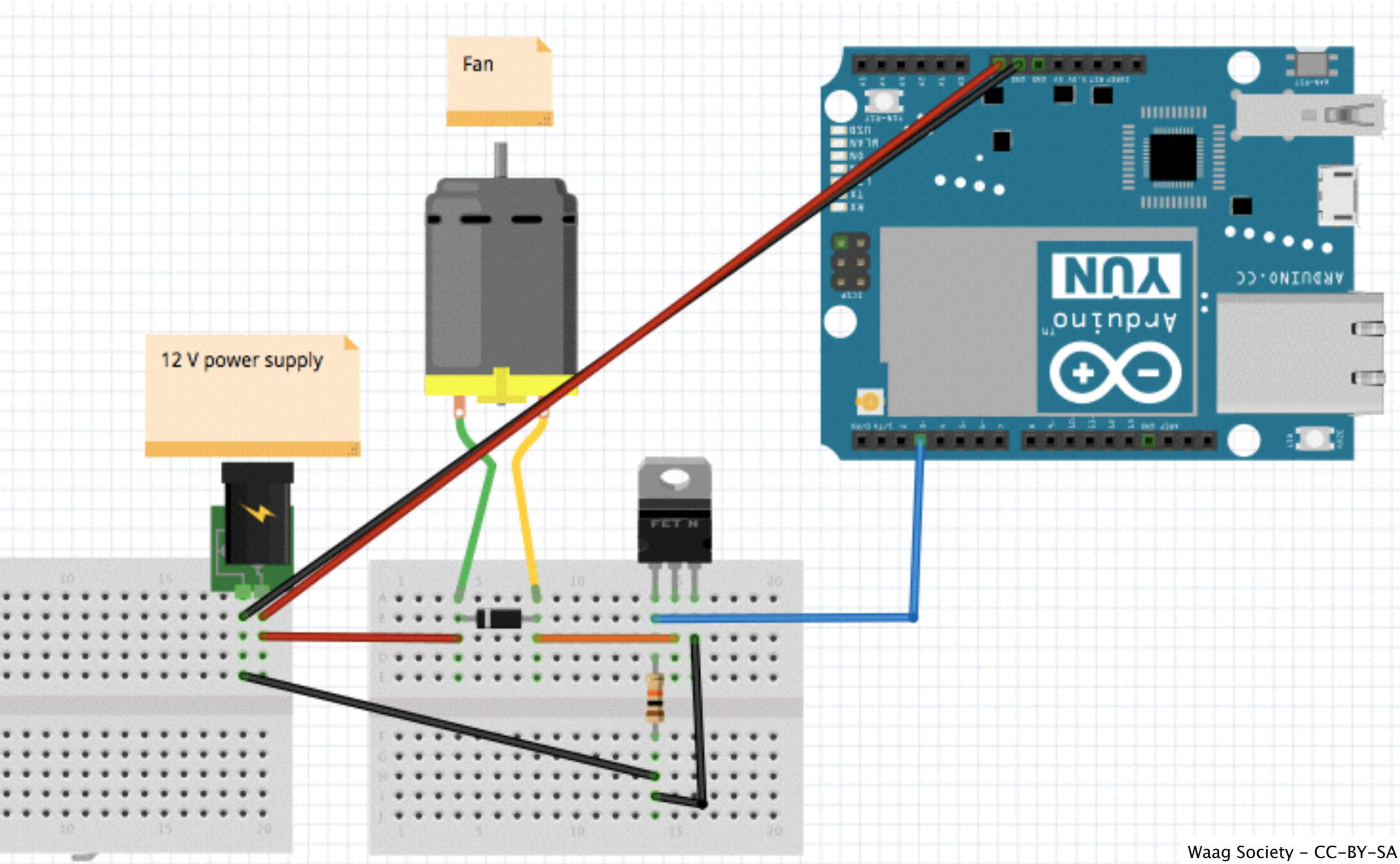
# Fan speed controller

- MOSFET
  - Semiconductor

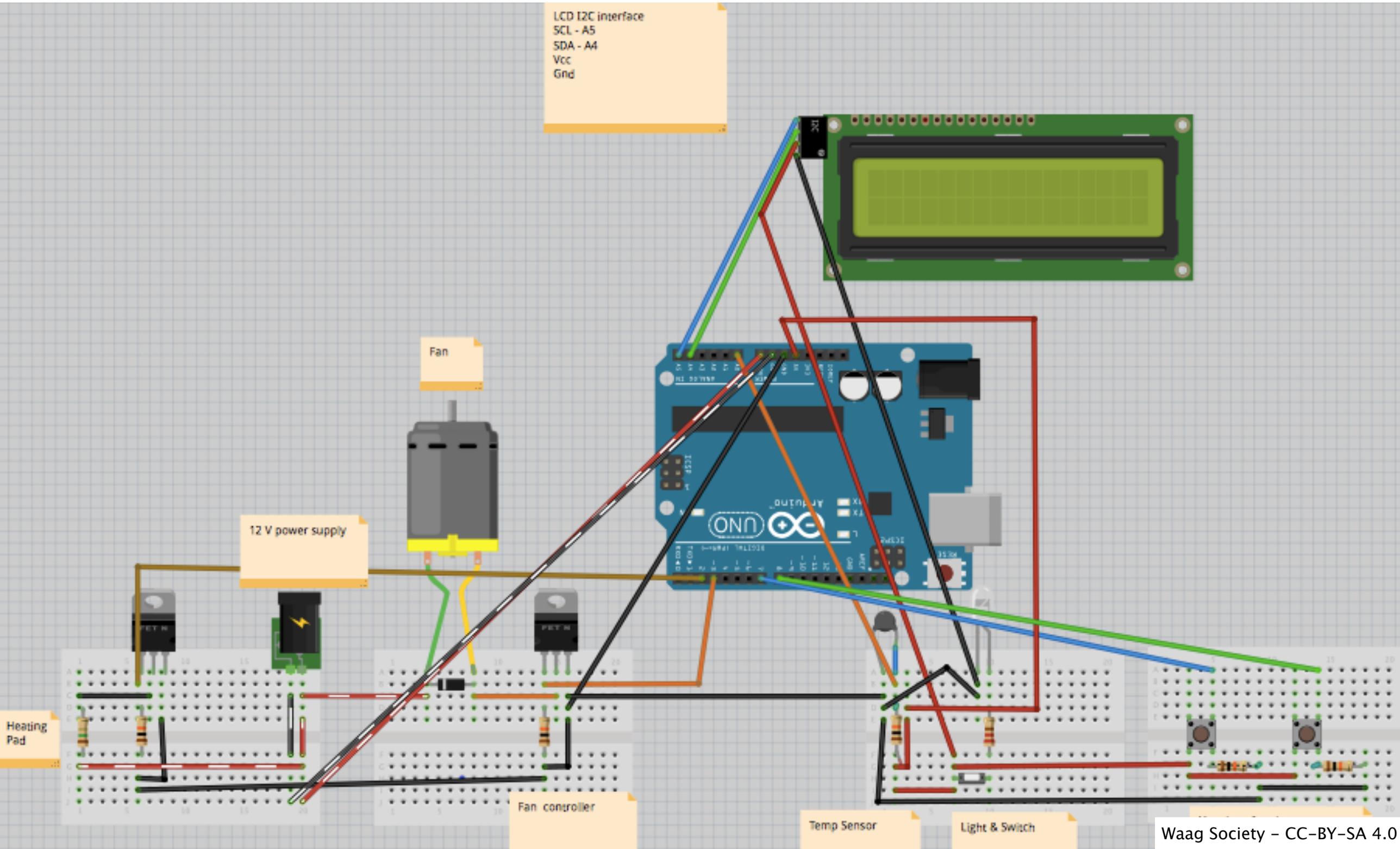
  - N-channel
  - 60V
  - 30A



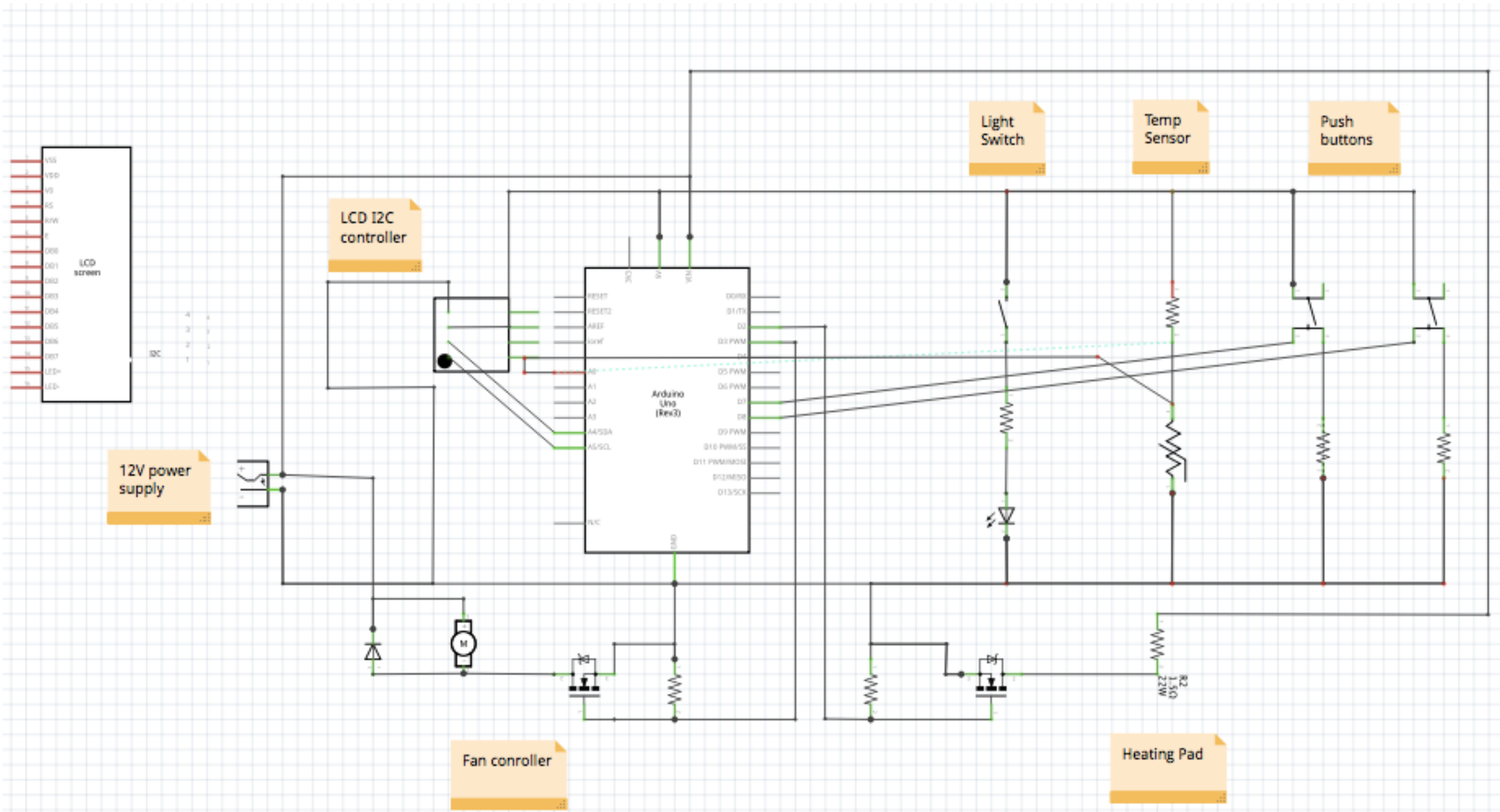
# Controlling the fan



# All of the electronics together



# Schematic



# Power Supply

$$P = A \times I$$

$$Power = Current \times Potential$$

$$Watt = Ampere \times Volt$$

- 1 x 30 mA LEDs
- 1 x 250 mA Arduino
- 1 x 400 mA Fan
- 1 x 30 mA 7 segment display
- 1 x 430 mA heating pad

- Total: 1140 mA
- So a 1.5 Amp power supply should be enough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# Arduino tutorial codes

- MOSFET code:
  - http://bildr.org/2012/03/rfp30n06le-arduino/
- Button code:
  - http://arduino.cc/en/tutorial/button
- Thermistor code:
  - http://computers.tutsplus.com/tutorials/how-to-read-temperatures-with-arduino--mac-53714

# Code

This repository Search Pull requests Issues Gist

BioHackAcademy / BHA_Incubator

Unwatch 3 Star 3 F

Branch: master BHA_Incubator / Arduino Code / +

V2

PieterVanBoheemen authored 26 days ago latest commit c27922af65

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| | | |
|---|---|---|
| Incubator.ino | V2 | 26 days ago |
| LiquidCrystal_I2C.cpp | V2 | 26 days ago |
| LiquidCrystal_I2C.h | V2 | 26 days ago |

# Code logic

- Measure temperature
  - Turn lamp on when temperature is lower than target
  - Turn lamp off when temperature is higher than target
- Check whether a button is pushed
  - If left button is pushed increase target temperature
  - If right button is pushed decrease target temperature
- Display current temperature
  - In case left or right button is pushed, display target temperature for 5 seconds

# Nice to haves

- PID control
- Magnetic door lock
- Lever switch that checks whether door is locked
- Sound alarm in case door is open for too long
- Webcam inside

# PID control