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# MAS Digital Fabrication

Thymio Workshop

October 1<sup>st</sup>, 2020

**ETH** zürich

**DARCH**

Departement Architektur

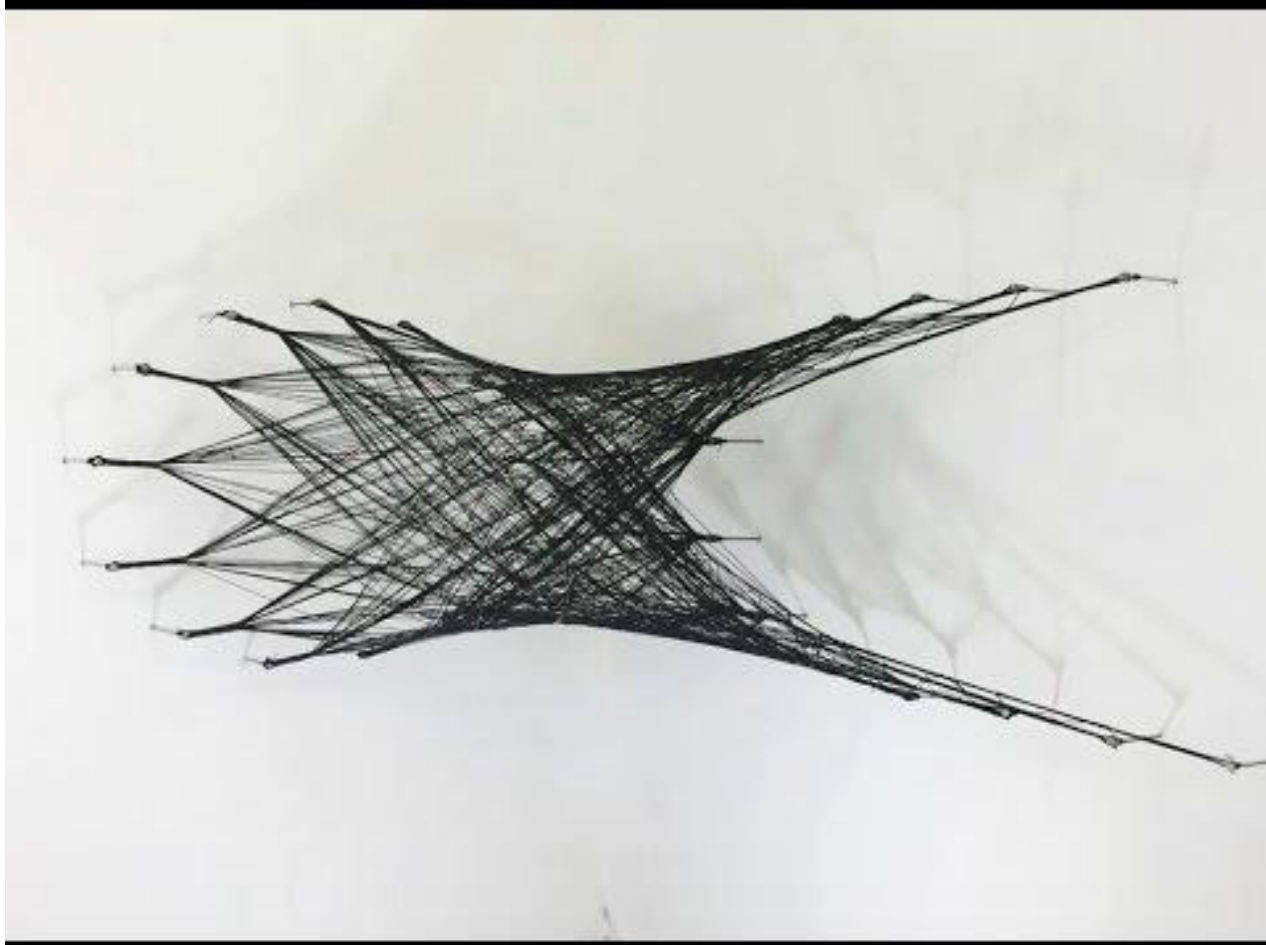
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Institute of Technology in Architecture  
Faculty of Architecture / ETH Zürich

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# Autonomous Printing

A machine that transforms its environment



Wall-climbing mini robots, ICD ITKE

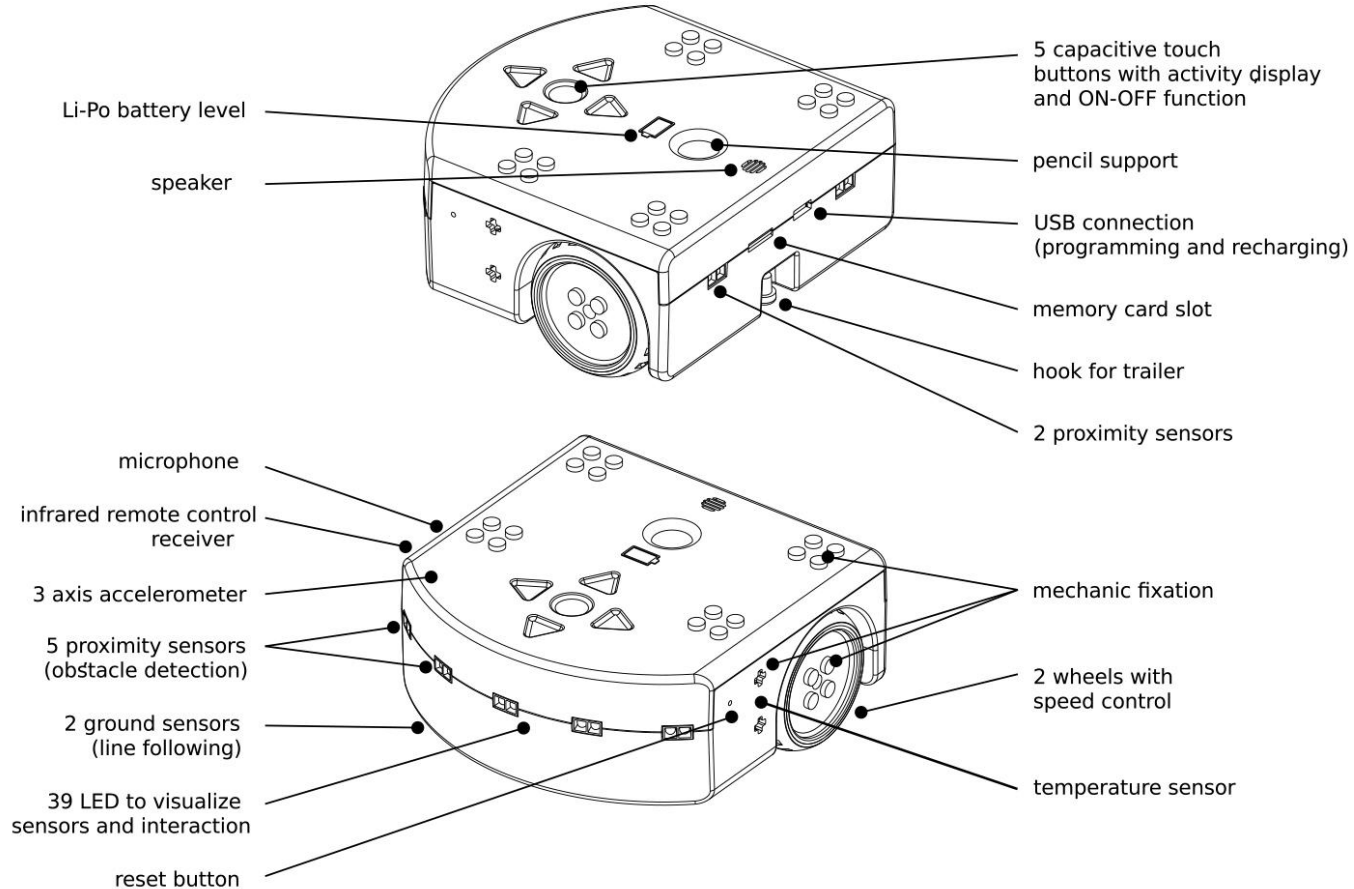


MeshMould and In Situ Fabricator, ETH Zurich



Thymio II robot

# Meet the robots



## Variables[index range]

### Events

### Functions

explanation,

condition, frequency of event,

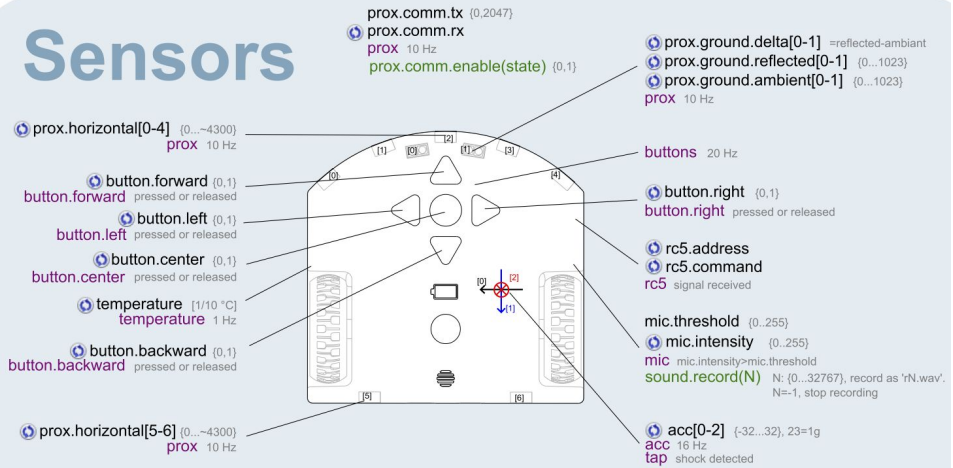
{range}

[unit]

variable updated automatically

timer.period[0-1] [ms]  
timer0 every timer.period[0] ms  
timer1 every timer.period[1] ms

## Sensors



leds.prox.h(led0, led1, led2, led3, led4, led5, led6, led7) {0...32}

leds.buttons(led0, led1, led2, led3) {0...32}

leds.circle(led0, led1, led2, led3, led4, led5, led6, led7) {0...32}

leds.bottom.left(red, green, blue) {0...32}

leds.temperature(red, blue) {0...32}

motor.left.target desired speed {-500...500}, 500 = ~20 cm/s

motor.left.speed actual speed

motor.left.pwm motor command

motor 100 Hz

leds.top(red, green, blue) {0...32}

leds.prox.h(led0, led1, led2, led3, led4, led5, led6, led7) {0...32}

leds.prox.v(led0, led1) {0...32}

leds.rc(led) {0...32}

leds.bottom.right(red, green, blue) {0...32}

leds.sound(led) {0...32}

motor.right.target desired speed {-500...500}, 500 = ~20 cm/s

motor.right.speed actual speed

motor.right.pwm motor command

motor 100 Hz

sound.finished a sound finished playing

sound.system(N) N: {0...7}, play system sound N. N=-1, stop playing

sound.freq(Hz,ds) [Hz],[1/60 s]

sound.wave(wave[142]) change primary wave, wave[i] : {-128...127}

sound.play(N) N: {0...32767}, play 'N.wav'. N=-1, stop playing

sound.replay(N) N: {0...32767}, replay 'N.wav'. N=-1, stop playing

## Actuators



# 6 pre-programmed behaviours



Friendly



Explorer



Fearful



Investigator

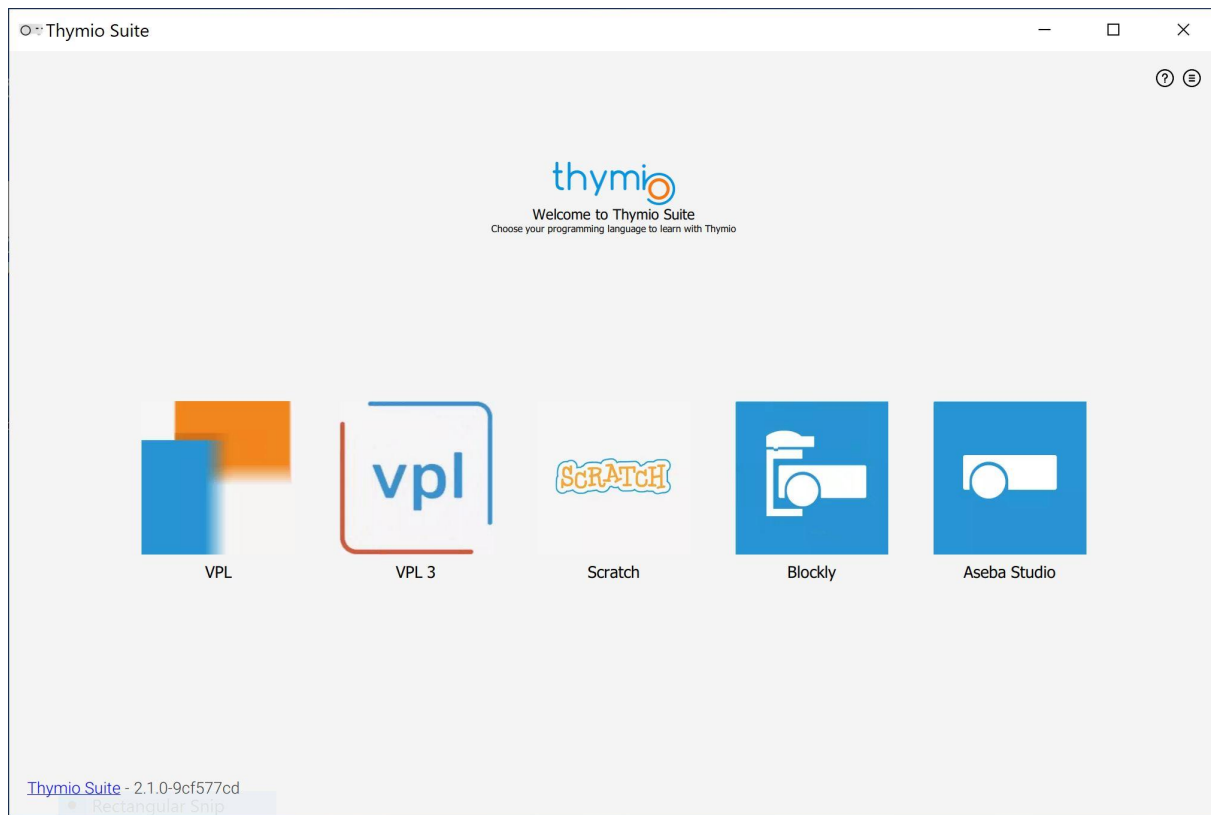


Obedient



Attentive

# Thymio Suite





## Code with blocks

Associate an event to an action and program  
Thymio to do what you want.



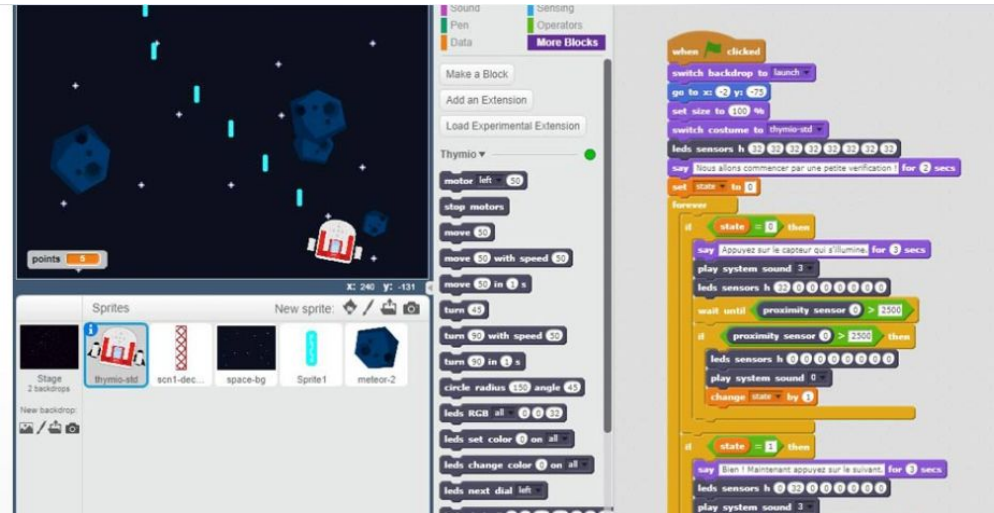
Start coding with VPL >

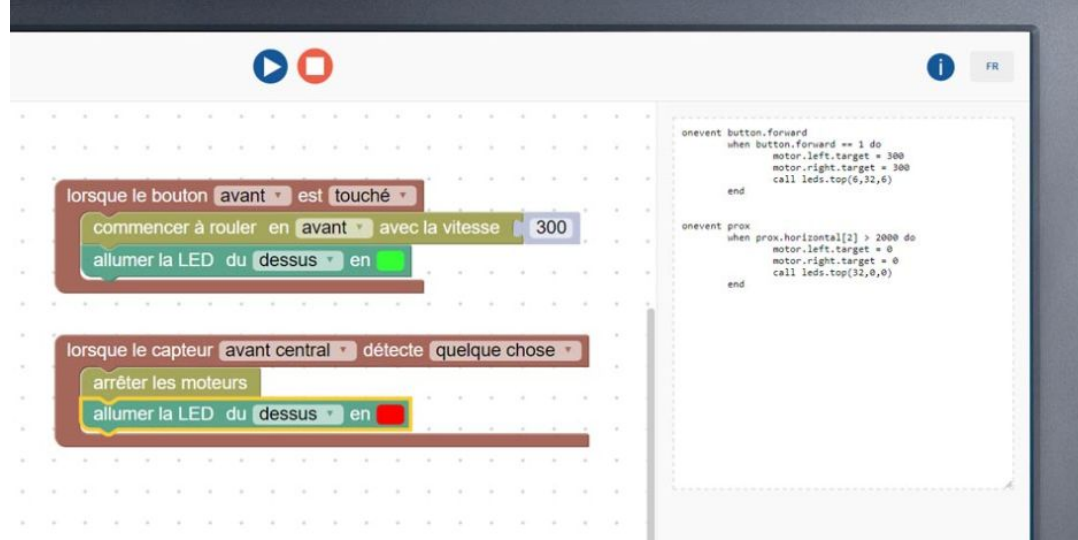


## Code with Scratch

Use Scratch to create more great things,  
for example a video game.

Start coding with Scratch >





## Code with Blockly

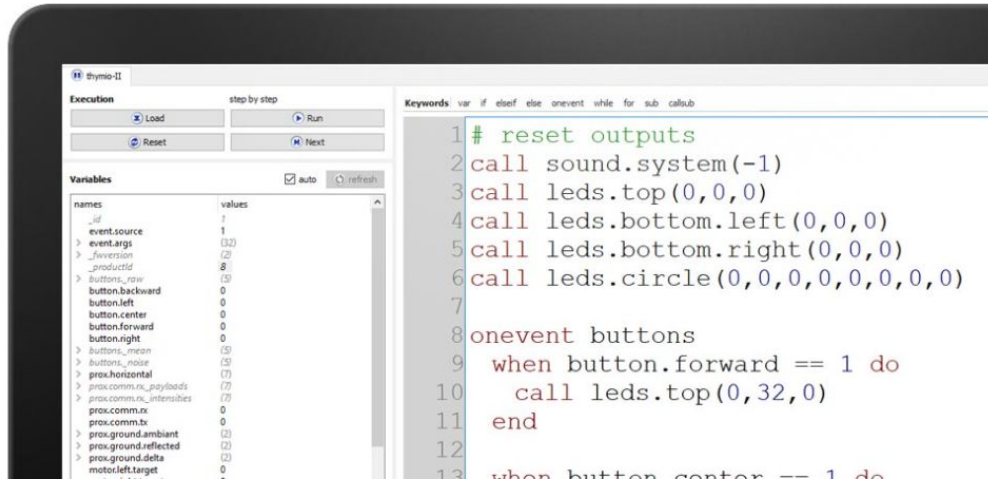
Use math, logic, loops, variables and discover more programming concepts!

[Start coding with Blockly](#)

## Code with Text

Discover all the possibilities of Thymio with the Aseba text language

[Start coding with text](#)



## Thymio follows your hand

The screenshot shows the Thymio programming interface. The top toolbar includes icons for file operations, a play button, a stop button, a Thymio robot icon, and a settings gear. The main workspace contains a sequence of programming blocks:

- A vertical column of icons on the left, including a play button, a Thymio robot, a directional pad, a color sensor, a line sensor, a hand sensor, and a camera.
- A sequence of five blocks, each consisting of a red dashed rectangle followed by a blue dashed rectangle with a central square and eight arrows pointing outwards.
- A final block consisting of a red dashed rectangle followed by a blue dashed rectangle.

At the bottom right, there are icons for a folder, a circle with a diagonal line, and a trash can, along with the text "EPFL 2018-2020".

## Thymio stops at the border of the table

The screenshot shows the Thymio programming interface. The top toolbar includes icons for file operations, a play button, a stop button, a Thymio robot icon, and a settings gear. The main workspace contains a sequence of programming blocks:

- A vertical column of icons on the left, including a play button, a Thymio robot, a directional pad, a color sensor, a line sensor, a hand sensor, and a camera.
- A sequence of three blocks, each consisting of a red dashed rectangle followed by a blue dashed rectangle with a central square and eight arrows pointing outwards.
- A final block consisting of a red dashed rectangle followed by a blue dashed rectangle.

At the bottom right, there are icons for a folder, a circle with a diagonal line, and a trash can, along with the text "EPFL 2018-2020".

## Thymio follows your hand

```
# reset outputs
call sound.system(-1)
call leds.top(0,0,0)
call leds.bottom.left(0,0,0)
call leds.bottom.right(0,0,0)
call leds.circle(0,0,0,0,0,0,0,0)

onevent prox
  when prox.horizontal[2] >= 2000 do
    motor.left.target = 350
    motor.right.target = 350
  end

  when prox.horizontal[0] >= 2000 do
    motor.left.target = 0
    motor.right.target = 500
  end

  when prox.horizontal[4] >= 2000 do
    motor.left.target = 500
    motor.right.target = 0
  end

  when prox.horizontal[0] <= 1000 and prox.horizontal[1]
<= 1000 and prox.horizontal[2] <= 1000 and
prox.horizontal[3] <= 1000 and prox.horizontal[4] <= 1000
do
    motor.left.target = 0
    motor.right.target = 0
  end
```

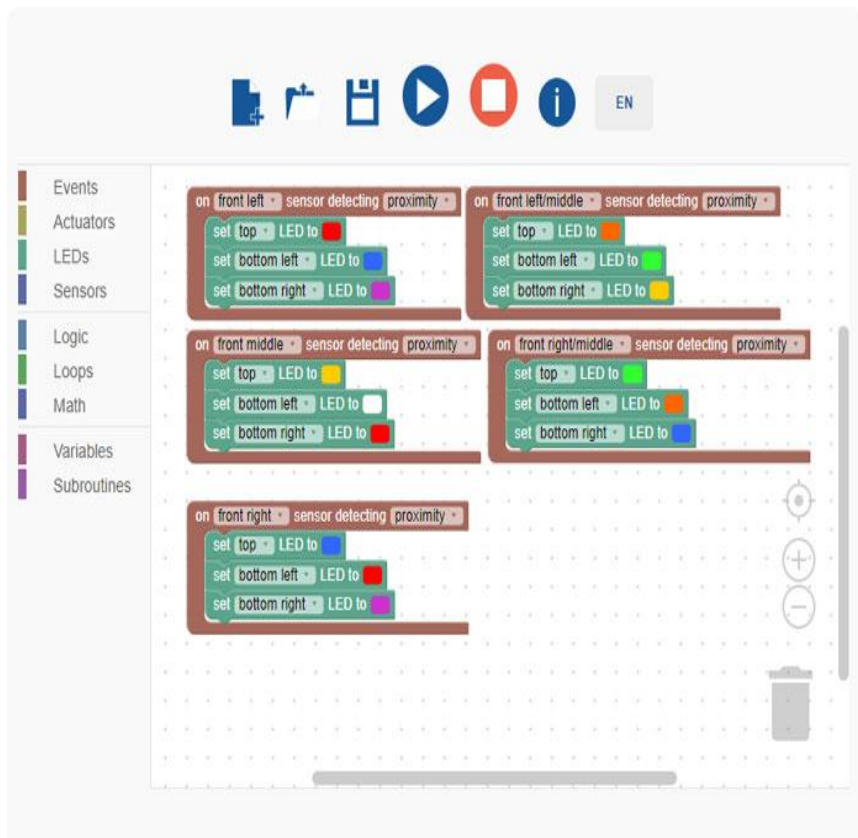
## Thymio stops at the border of the table

```
# reset outputs
call sound.system(-1)
call leds.top(0,0,0)
call leds.bottom.left(0,0,0)
call leds.bottom.right(0,0,0)
call leds.circle(0,0,0,0,0,0,0,0)

# Thymio moves forward when you press the forward button
onevent buttons
  when button.forward == 1 do
    motor.left.target = 200
    motor.right.target = 200
  end

# if the ground sensors detects nothing Thymio becomes red
otherwise he becomes green
onevent prox
  if prox.ground.delta[0] <= 400 or prox.ground.delta[1]
<= 400 then
    motor.left.target = 0
    motor.right.target = 0
    call leds.top(32,0,0)
  else
    call leds.top(0,32,0)
  end
```

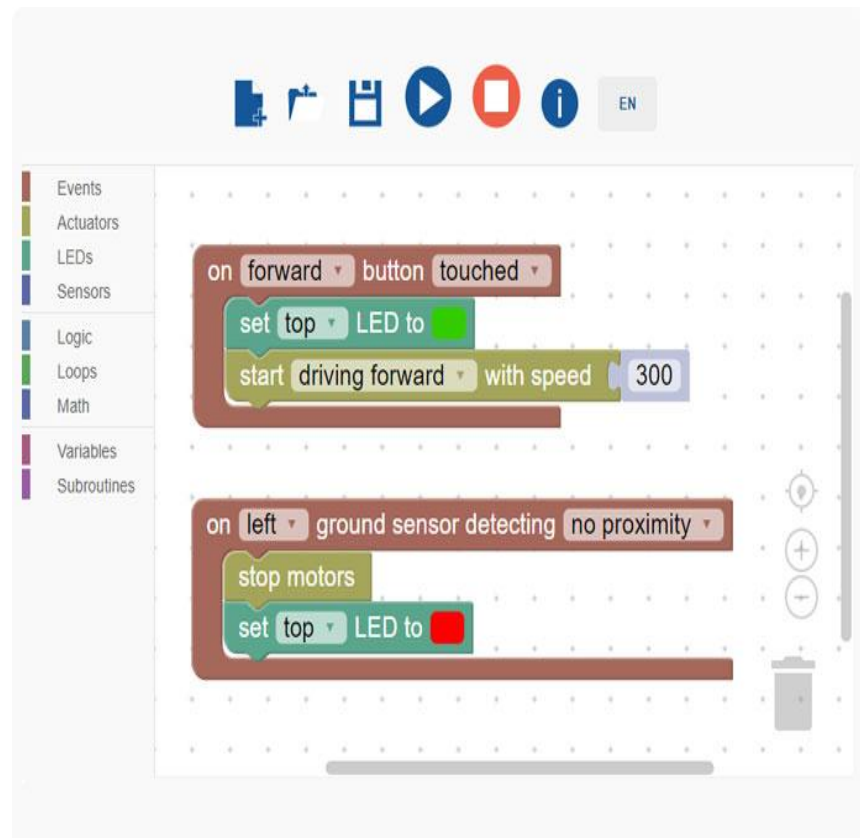
## Front sensors make Thymio change color



The interface shows a sidebar with categories: Events, Actuators, LEDs, Sensors, Logic, Loops, Math, Variables, and Subroutines. The main workspace contains five blocks, each triggered by a different front sensor detecting proximity:

- on front left sensor detecting proximity**: set top LED to red, bottom left LED to blue, bottom right LED to purple.
- on front left/middle sensor detecting proximity**: set top LED to orange, bottom left LED to green, bottom right LED to yellow.
- on front middle sensor detecting proximity**: set top LED to yellow, bottom left LED to white, bottom right LED to red.
- on front right/middle sensor detecting proximity**: set top LED to green, bottom left LED to orange, bottom right LED to blue.
- on front right sensor detecting proximity**: set top LED to blue, bottom left LED to red, bottom right LED to purple.

## Thymio stops at the border of the table



The interface shows a sidebar with categories: Events, Actuators, LEDs, Sensors, Logic, Loops, Math, Variables, and Subroutines. The main workspace contains two blocks:

- on forward button touched**: set top LED to green, start driving forward with speed 300.
- on left ground sensor detecting no proximity**: stop motors, set top LED to red.

# Ideas

ephemeral

immaterial

unpredictable

communicative



# Setting

17	Students
16	Thymio Robots
5	Teams of 3 - 4
6	Hours
2	boxes of LEGO
30 CHF	budget per group

# References

Hektor, Jürg Lehni

Lauf der Dinge, Fischli Weiss

Bike Water Printer

Roman Signer

Metamatic, Jean Tinguely

do nothing machine, Eames

Ventilator, Olafur Eliason

Architectural Time Machine, Haechan Park

Turtle graphics

Useless machine, Marvin Minsky

# Schedule

10.00 - 10.30	Intro/ Groups + Thymio Handout
10.30 - 12.00	Tryout + Develop your idea
12.00 - 12.30	Lunch
12.30 - 14.00	Short presentation by every student (max. 5min)
14.00 - 15.00	Group Discussions/ Questions (10 min per group)
17.30 - 18.30	Final Presentation (1 slide, title and live demo) and Award Ceremony

# Rules

Stay safe

Respect property

Keep clean or clean up

Wear your mask

Have fun

# Awards

- Incredible Machine Award
- AI Award

Bonus Points : Art and Aesthetics

# Resources

- Thymio.org
- [MAS-2021 repository](#)
- ETH Store
- Coop Bau & Hobby, Oerlikon (80)
- Jumbo, Escher-Wyss (80 Triemli, 13)

# Thymio Examples

[ECAL Thymio](#)

[Cirque du Thymio](#)

[More Thymio](#)

[More Thymio](#)

# Tutorials

VPL3

<https://www.thymio.org/program/vpl3/vpl3-documentation/>

<https://www.thymio.org/program/vpl3/>

Aseba Text

<http://wiki.thymio.org/en:thymiotutorielp1>

Blocky

<https://www.thymio.org/program/blockly/>



