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# MAS Digital Fabrication

Thymio Workshop

October 1st, 2020

ETH zürich
DARCH
Departement Architektur
Institute of Technology in Architecture
Faculty of Architecture / ETH Zurich
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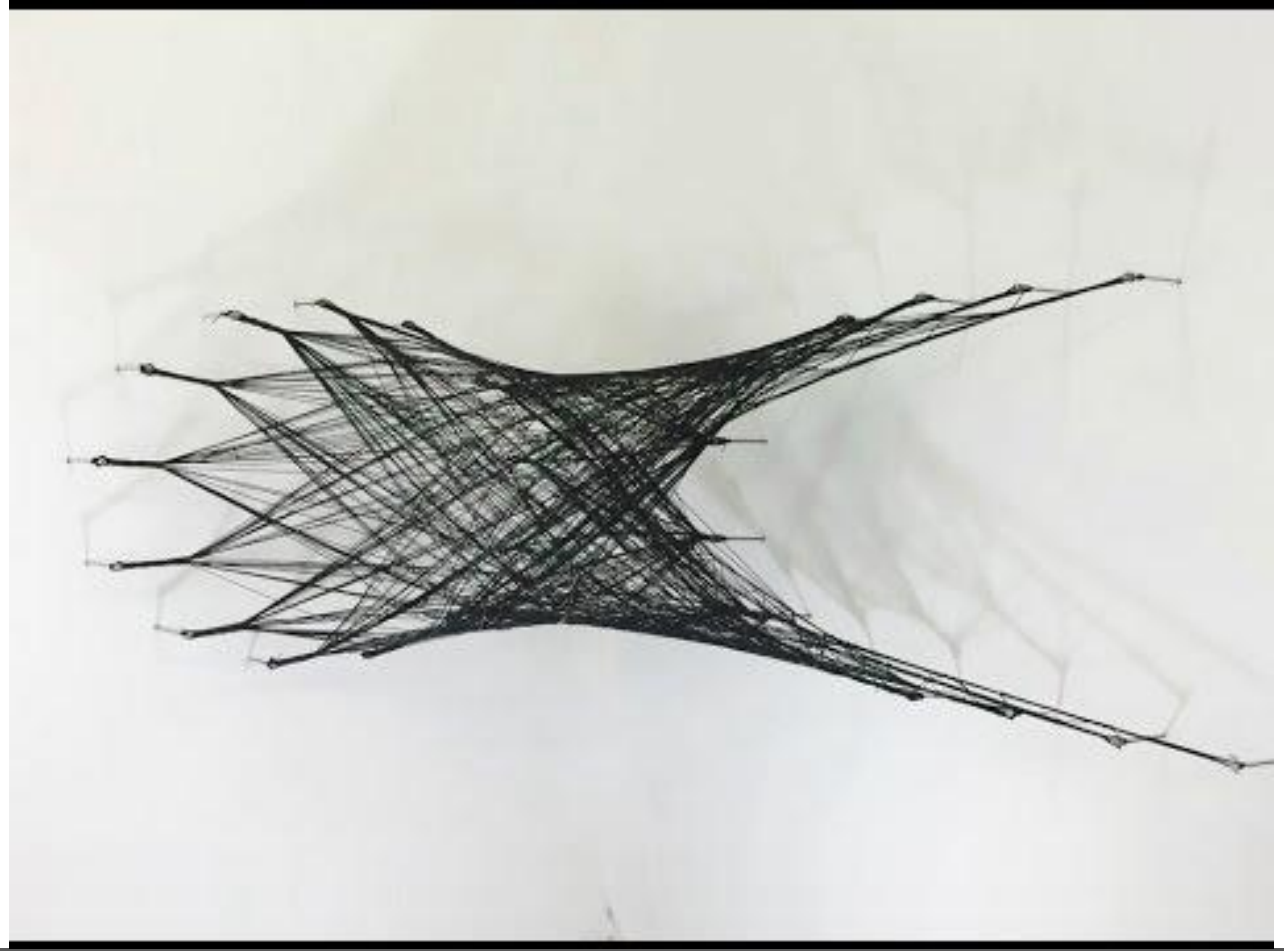
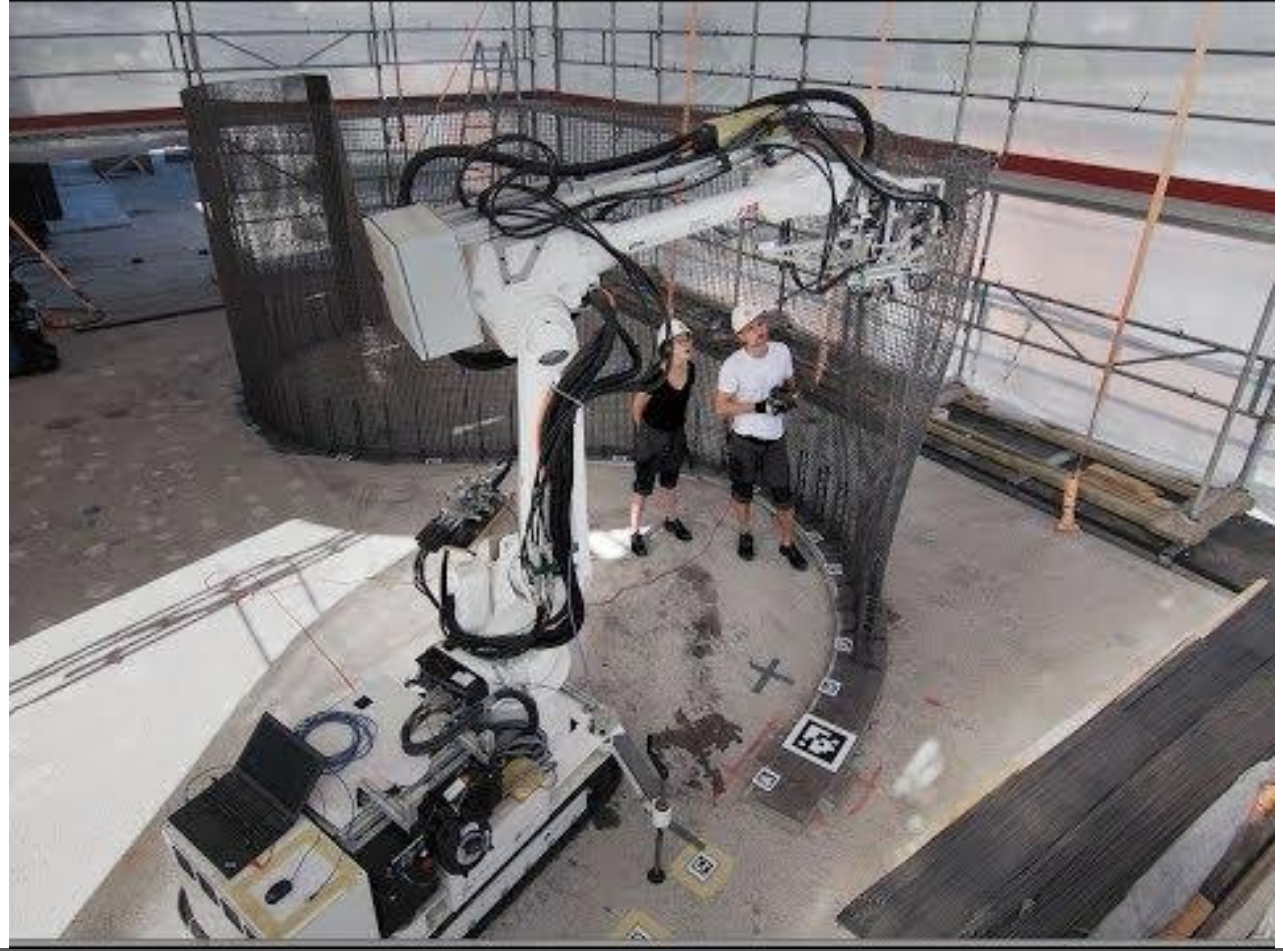
# Autonomous Printing

A machine that transforms its environment



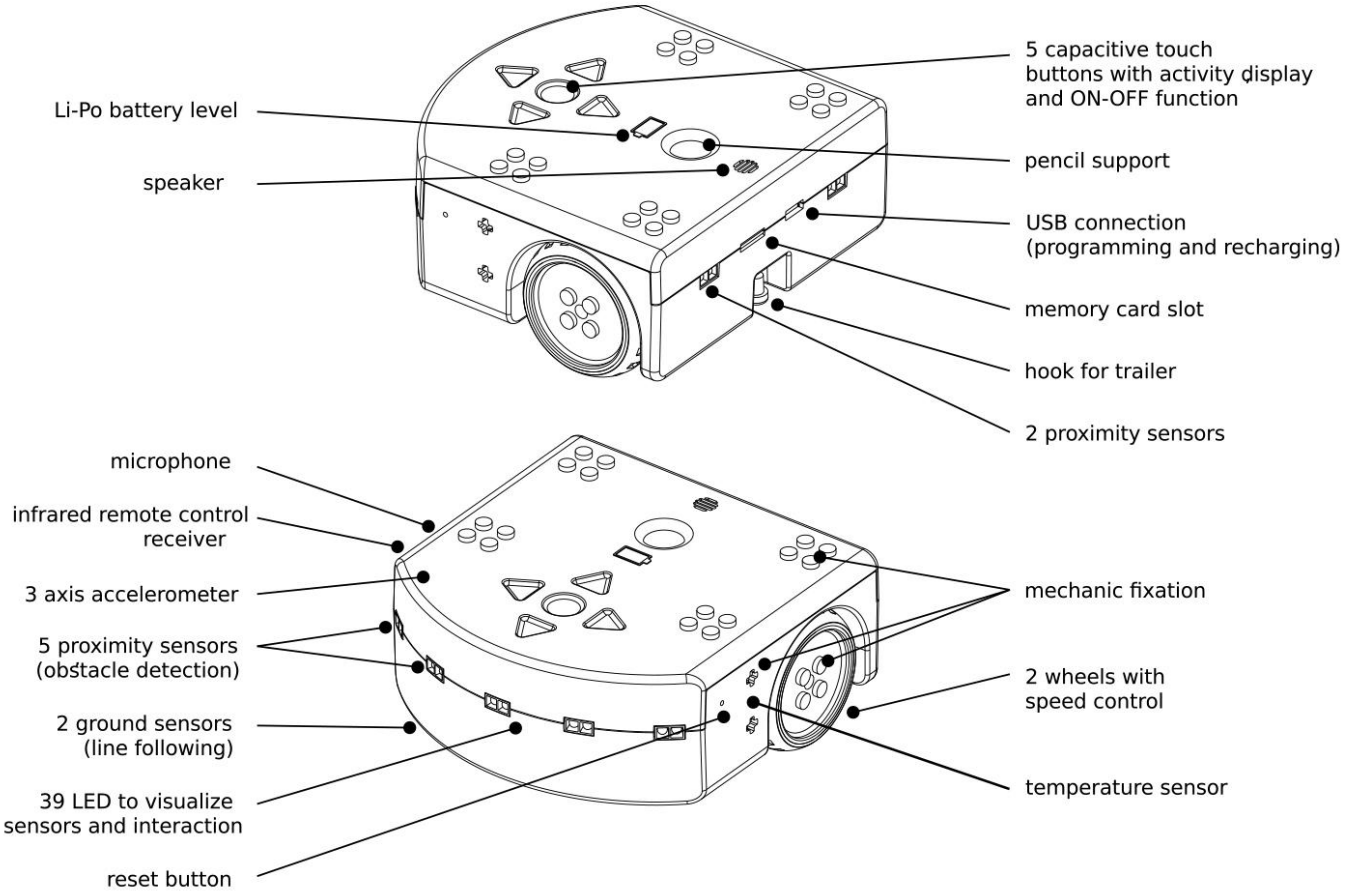
Wall-climbing mini robots, ICD ITKE



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

prox.comm.tx {0,2047}
prox.comm.rx
prox 10 Hz
prox.comm.enable(state) {0,1}

prox.ground.delta[0-1] =reflected-ambiant
prox.ground.reflected[0-1] {0...1023}
prox.ground.ambient[0-1] {0...1023}
prox 10 Hz

prox.horizontal[0-4] {0...~4300}
prox 10 Hz

buttons 20 Hz

button.forward {0,1}
button.forward pressed or released

button.left {0,1}
button.left pressed or released

button.center {0,1}
button.center pressed or released

button.right {0,1}
button.right pressed or released

temperature [1/10 °C]
temperature 1 Hz

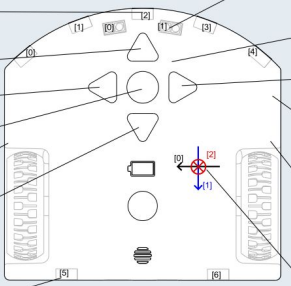
rc5.address
rc5.command
rc5 signal received

button.backward {0,1}
button.backward pressed or released

mic.threshold {0..255}
mic.intensity {0..255}
mic mic.intensity>mic.threshold
sound.record(N) N: {0...32767}, record as 'rN.wav'. N=-1, stop recording

prox.horizontal[5-6] {0...~4300}
prox 10 Hz

acc[0-2] {-32...32}, 23=1g
acc 16 Hz
tap shock detected




# Actuators

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}

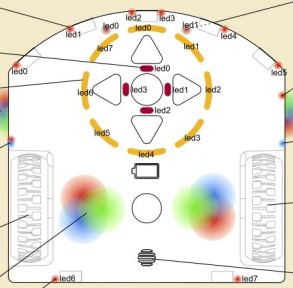
leds.bottom.left(red, green, blue) {0...32}

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

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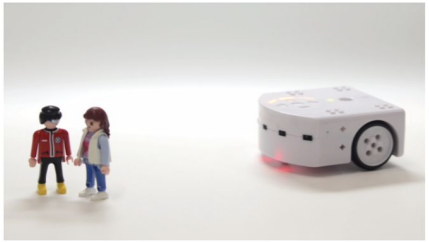
# 6 pre-programmed behaviours

Friendly



Explorer

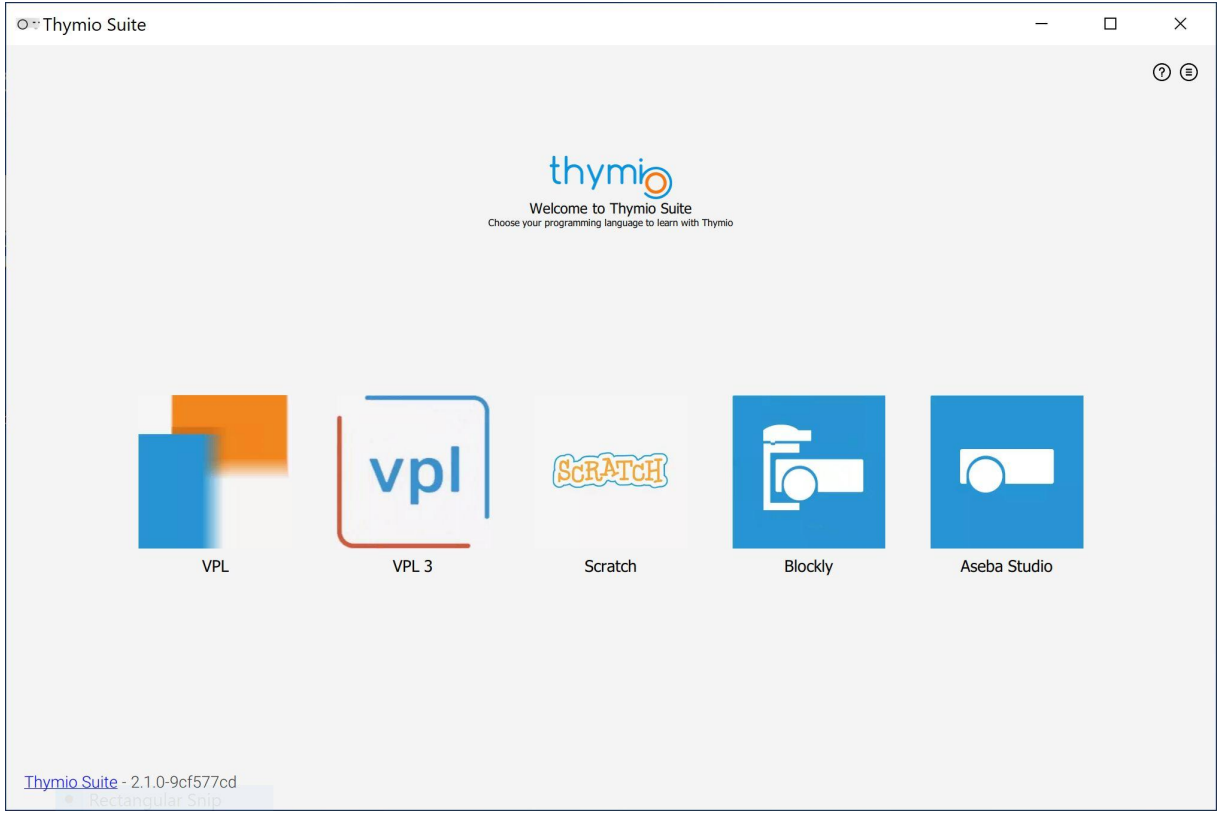
Fearful

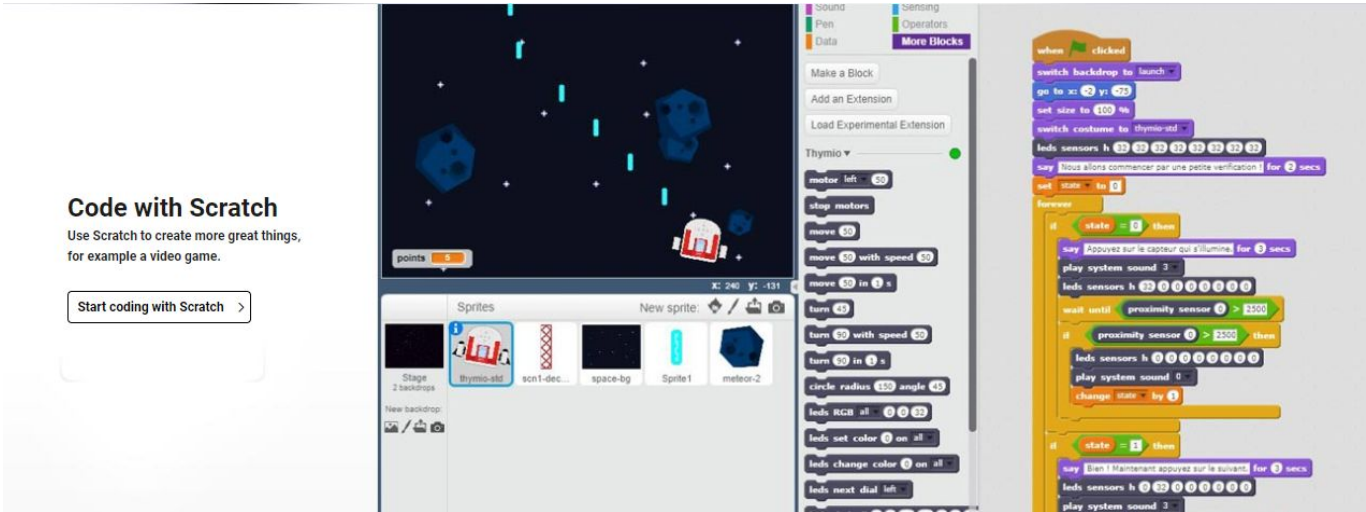
Investigator


Obedient

Attentive

# Thymio Suite

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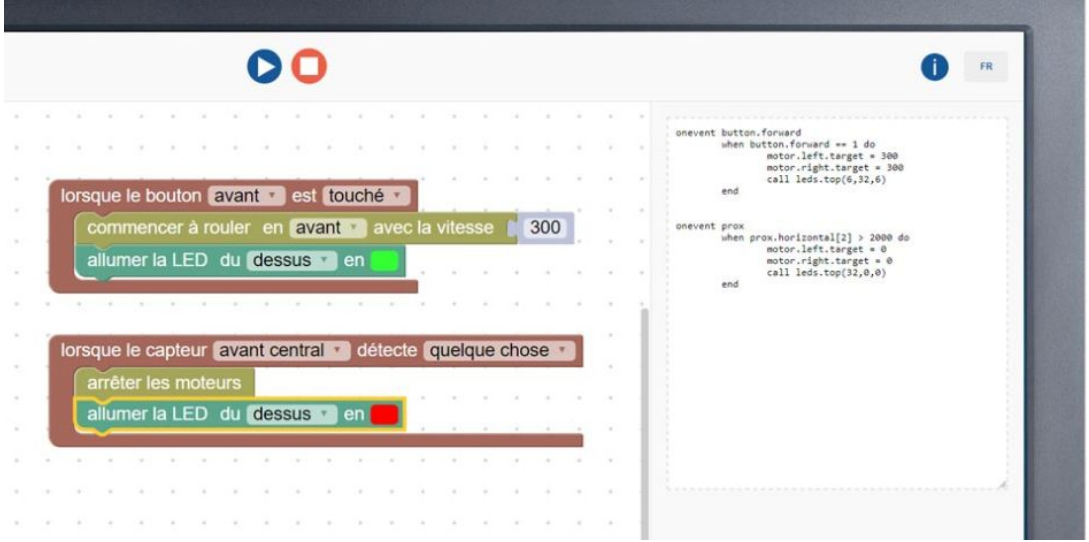
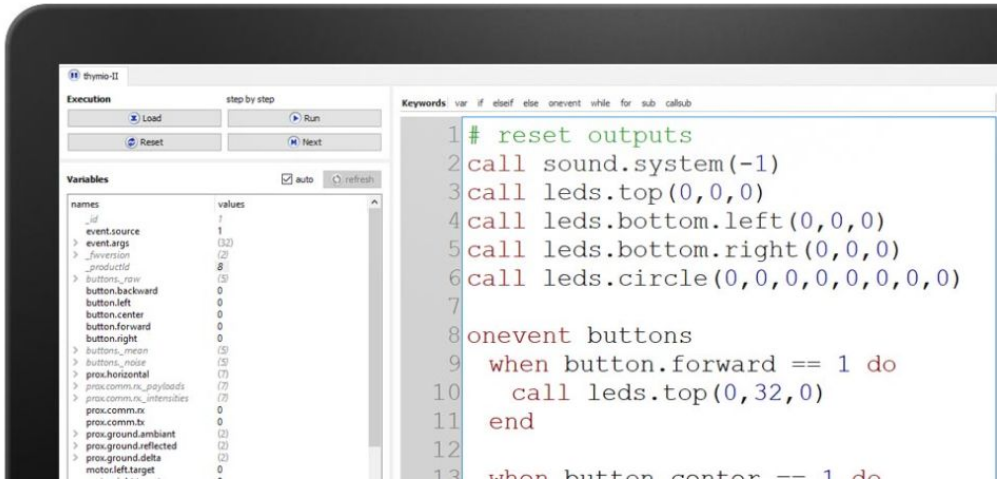



## Code with Blockly

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 ›

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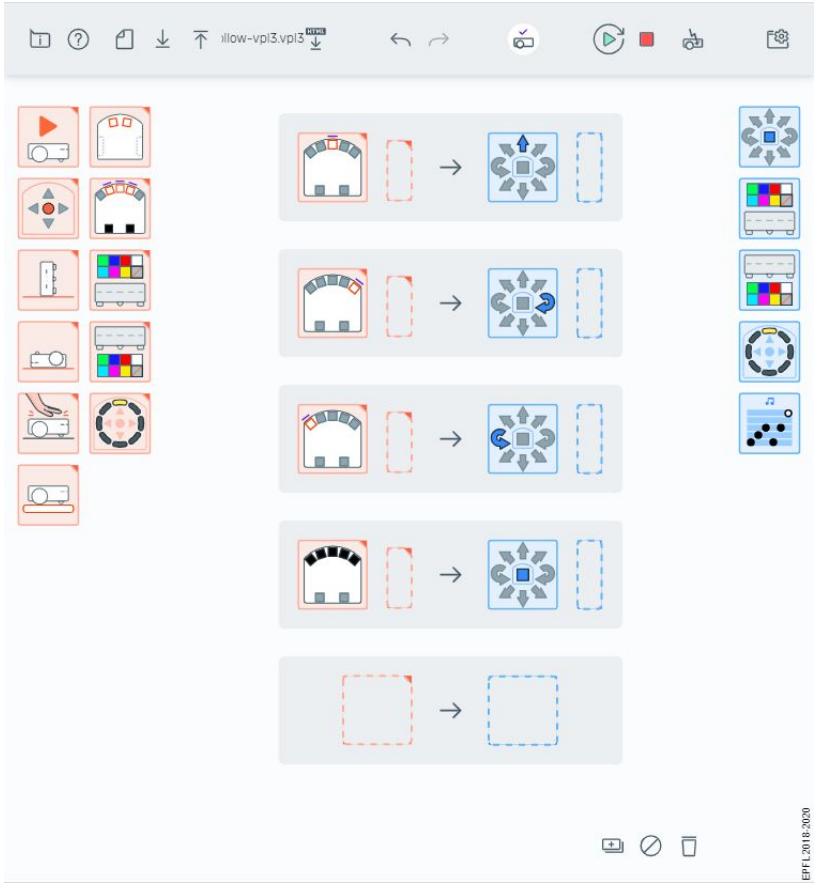
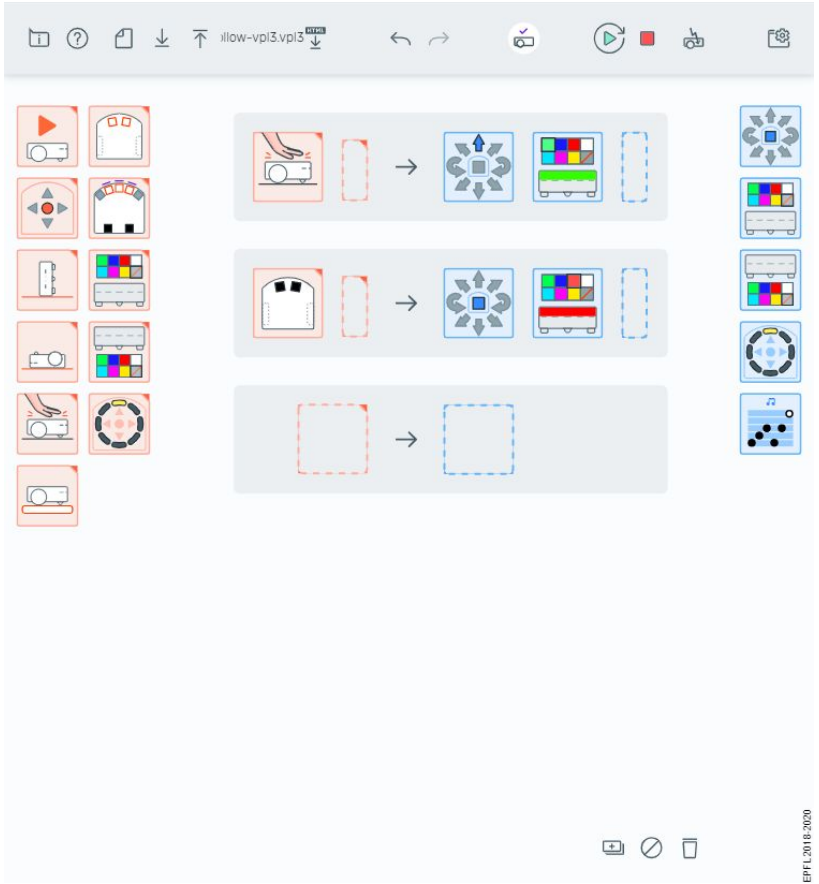
## Thymio follows your hand




## Thymio stops at the border of the table



## 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
```

# 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

VPL
http://wiki.thymio.org/en:visualprogramming

Aseba Text

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

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