RoboGen project

How to build your robot

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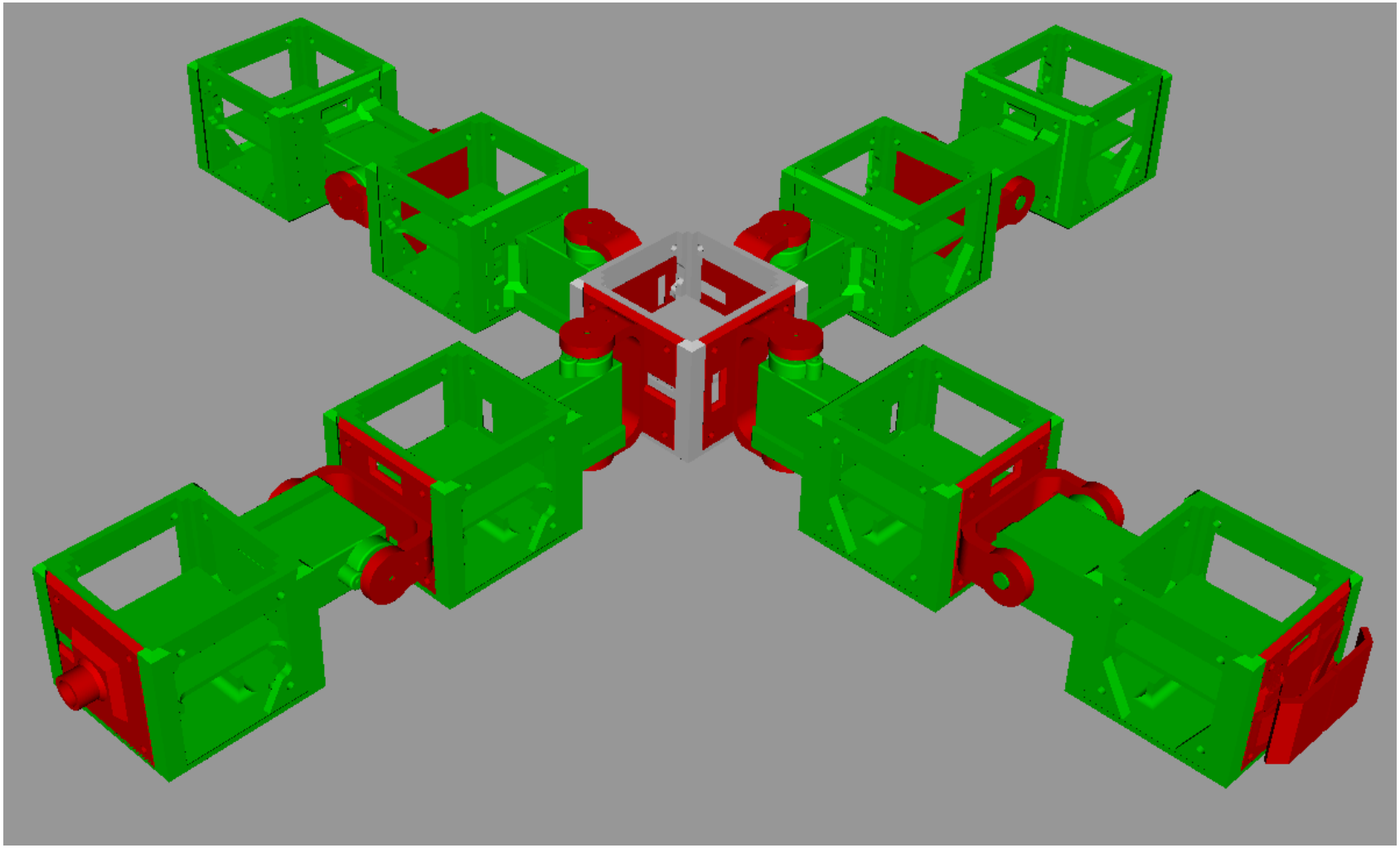
Topics today

1. Resources for building
2. Mechanical elements to build your robots
3. Technologies of 3D printing
4. How to print
5. Electronics used in the project
6. Assembling the robot
7. Programming the robot

Robot in simulator



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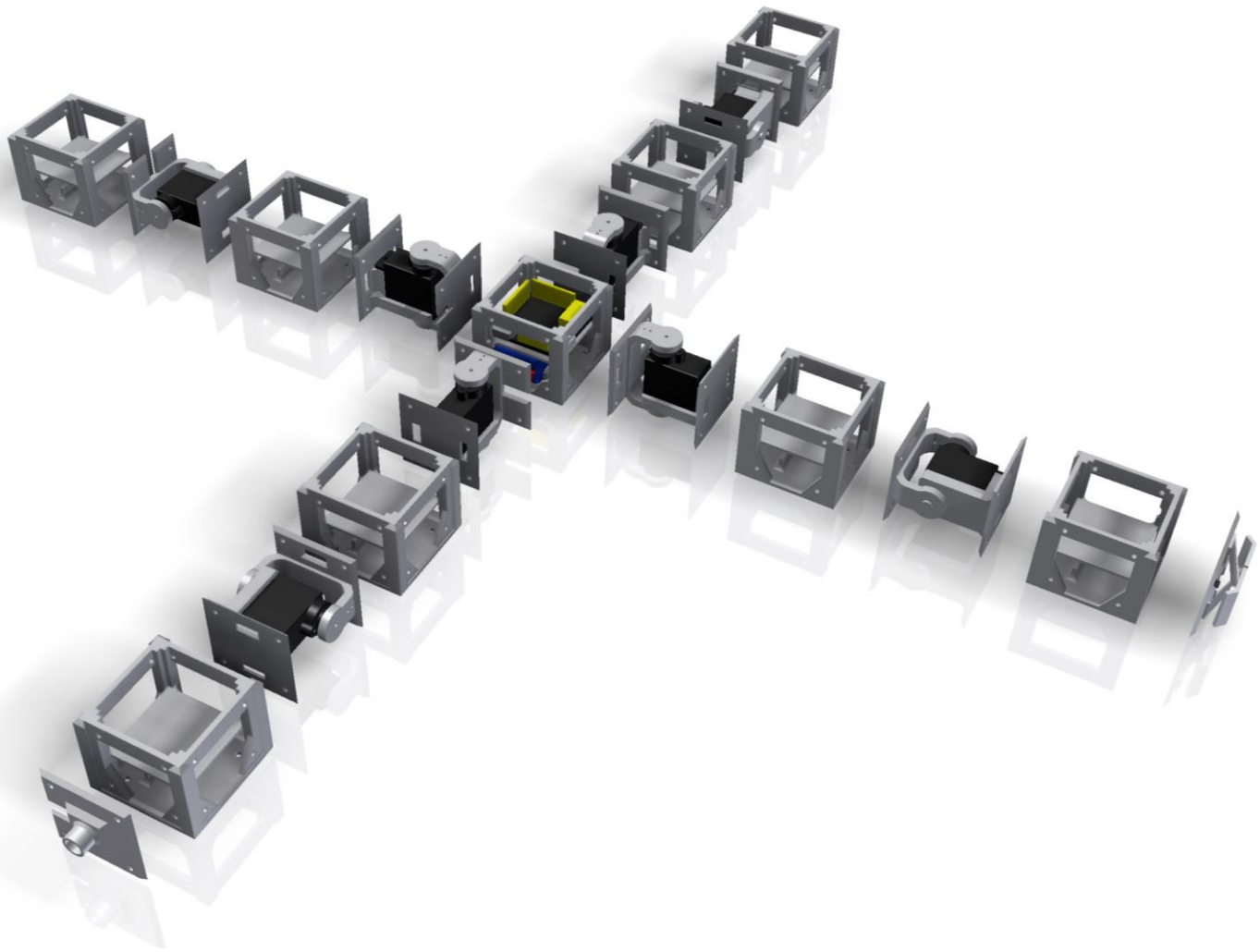
Real robot – exploded view



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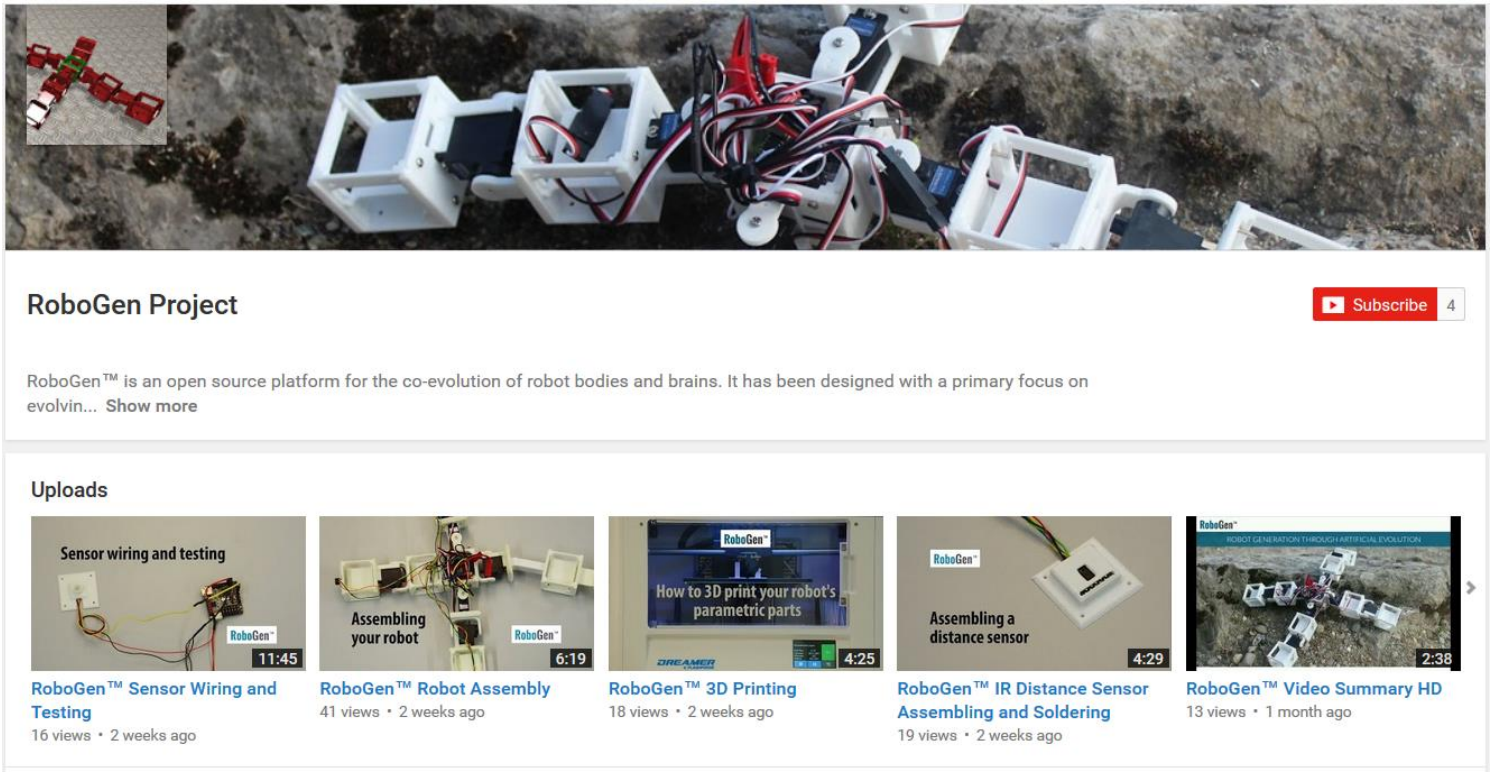
How to build your robot

Video tutorials for mechanics, electronics and 3D printing are available YouTube channel [RoboGen Project]() or [http://robogen.org/docs/video-tutorials/]()



More information in the next slides and on the [RoboGen]() website

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Mechanics

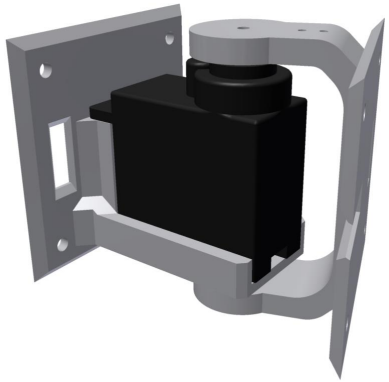
Types of components

Core

Sensors

Components

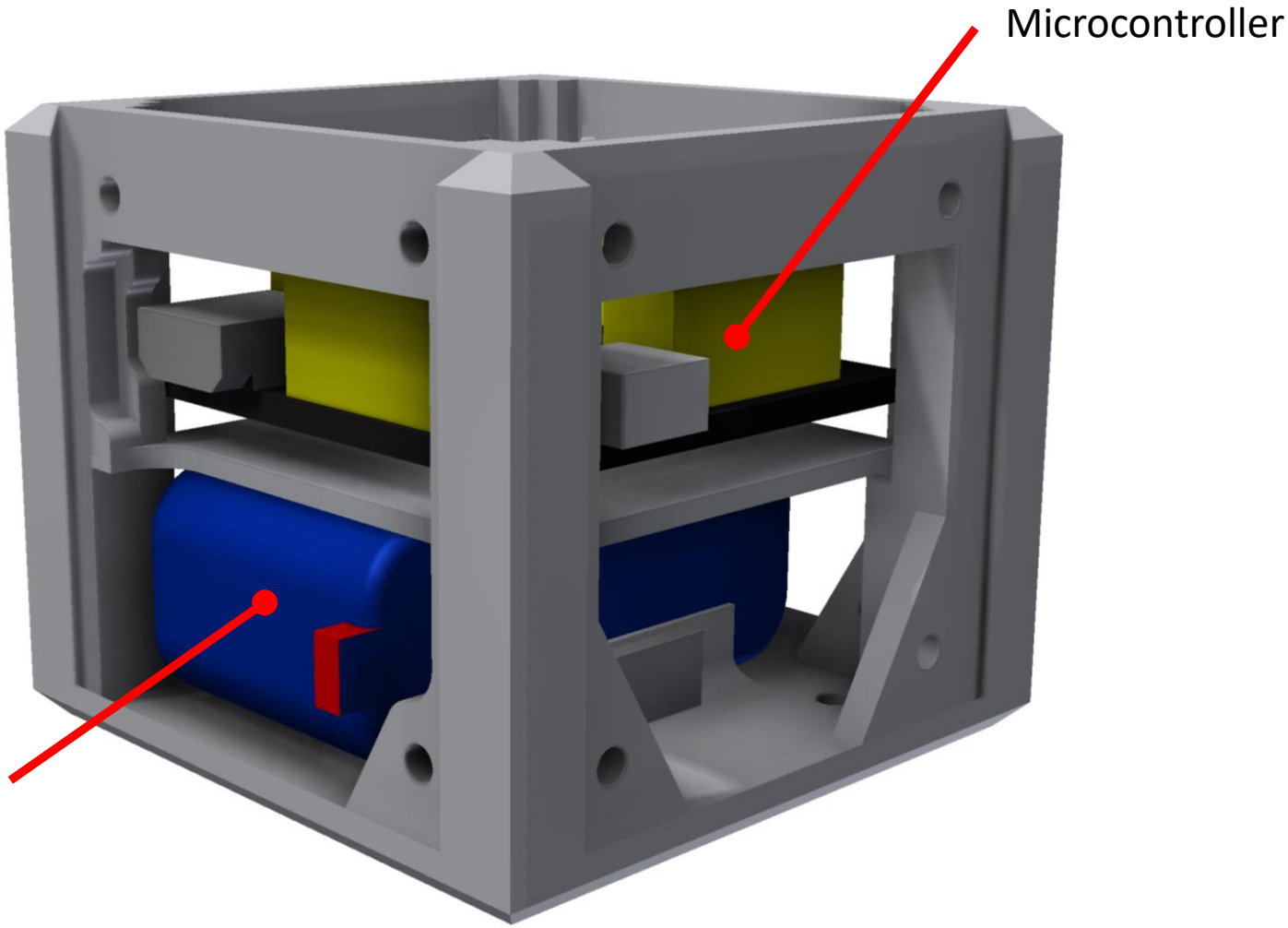
Joints



Connection elements

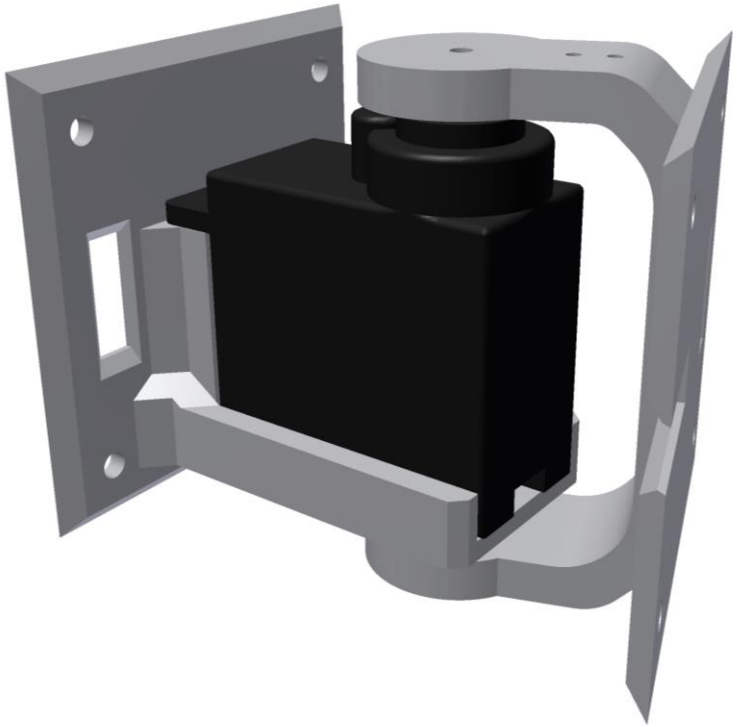
Parametric joints

Core component

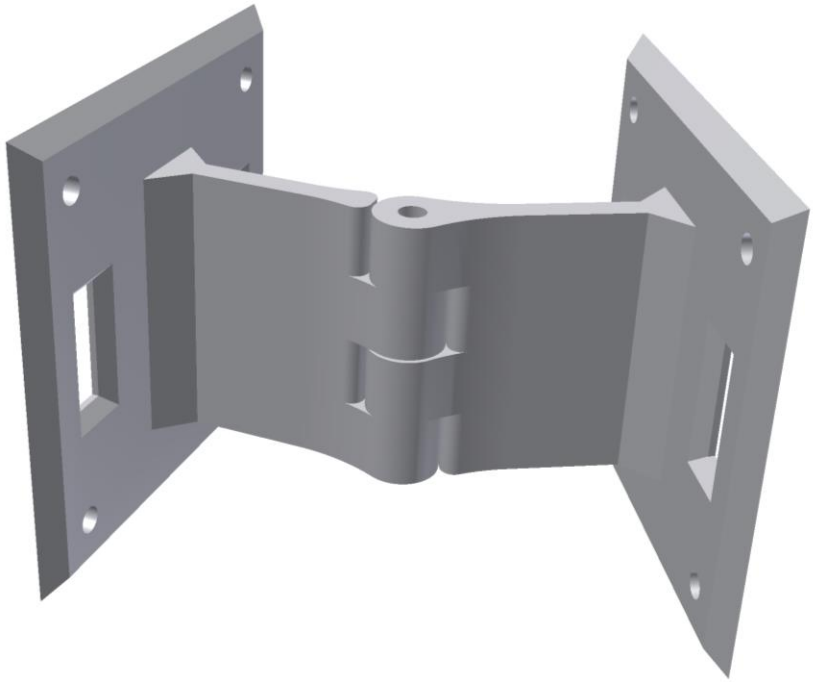


Joints

Active

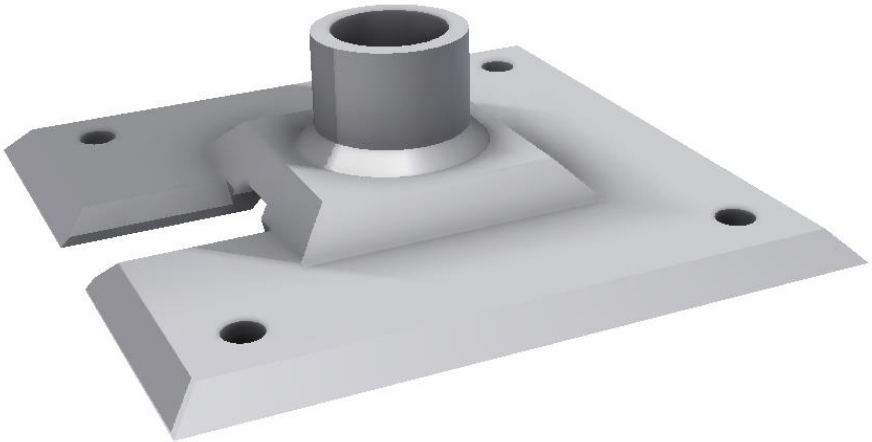


Passive

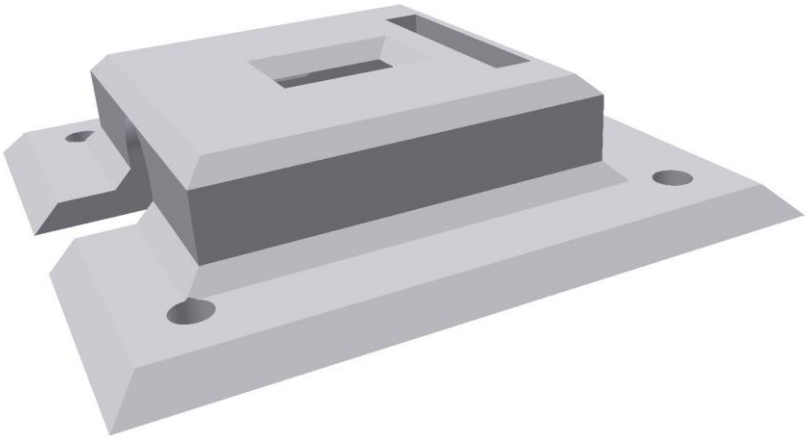


Sensors

Light sensor

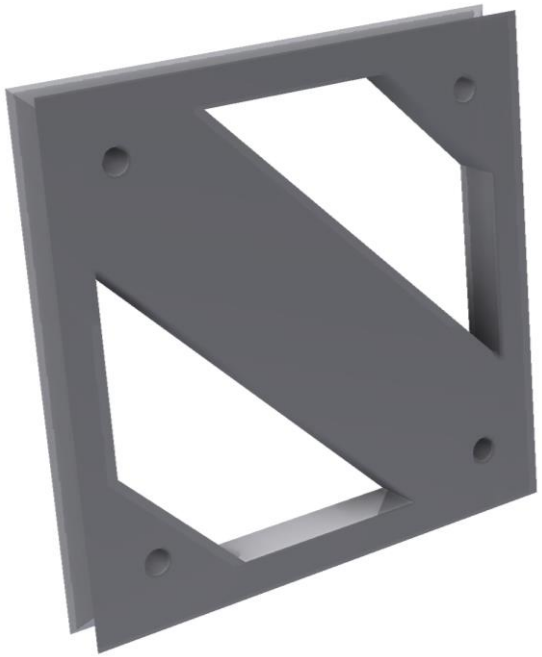


IR distance sensor



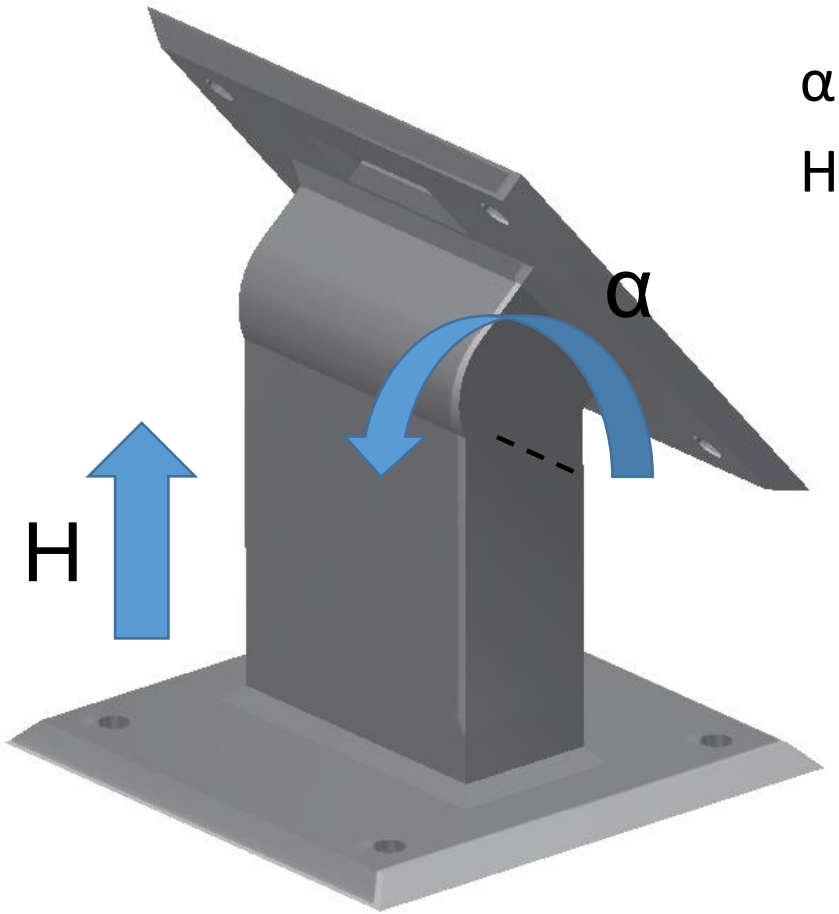
Connection elements

Between Cores



Between Joints

Parametric joint



α - angle

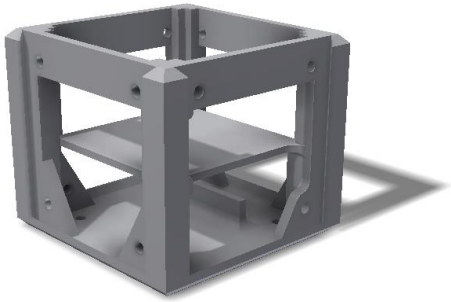
H – height

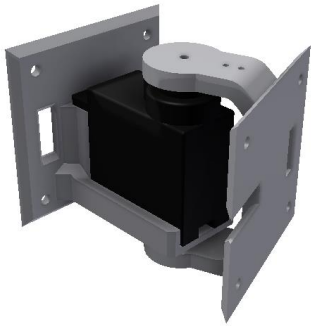
3D printed elements

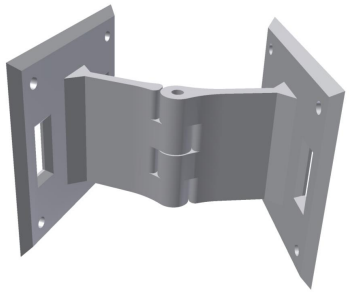
All pre-printed part are made with **SLS** technology for robustness and repeatability

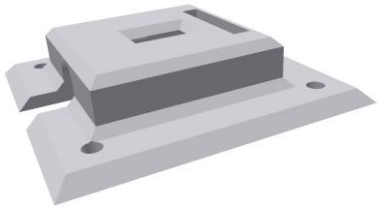
You will be given a set of:

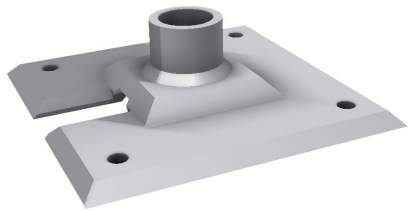
- 7x FixedBrick
- 8x Active Hinge (including servo motors)
- 1 passive hinges
- 4x IR sensor
- 3 connecting part of each type











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3D printed elements (2)

The part that you may have to 3D print yourself
(depending on your evolved robot) is the parametric joint

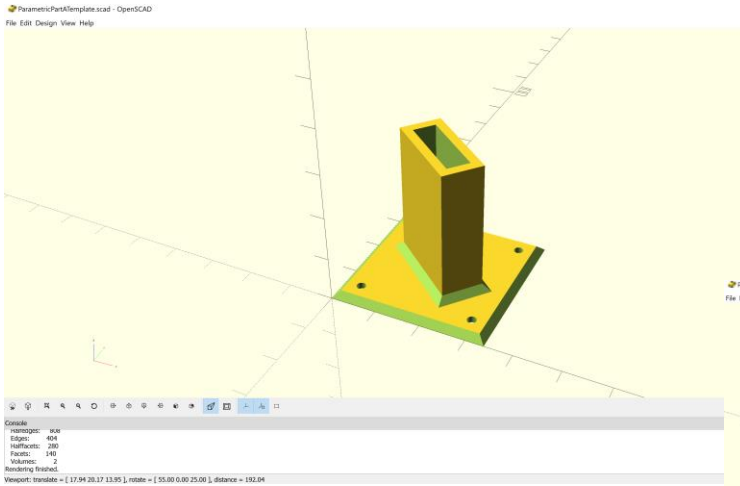
The printing files for all parts are on GitHub, those for the parametric joints will be generated by the software using OpenSCAD

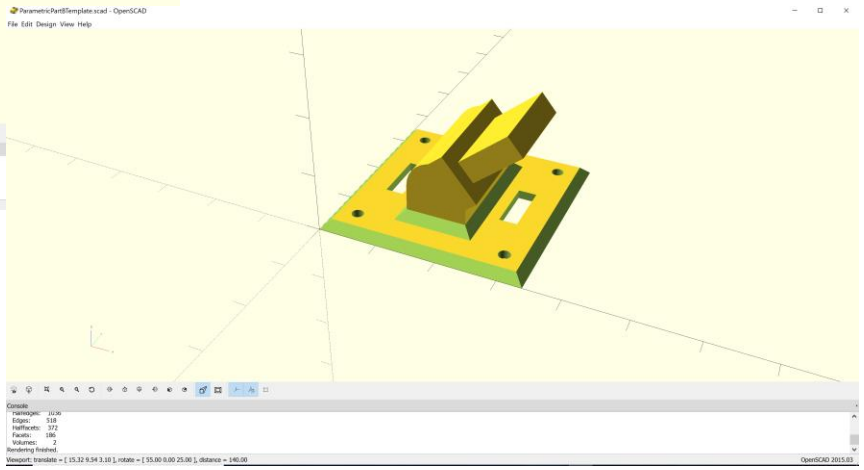
https://github.com/lis-epfl/robogen/tree/cutting_edge/printing-3D

For more information:
http://robogen.org/docs/building-your-robot/#3D-print

Parametric parts

- Genetically defined parametric parts will be automatically generated by OpenSCAD scripts to *.stl files
- Change angle and length parameters of the joint





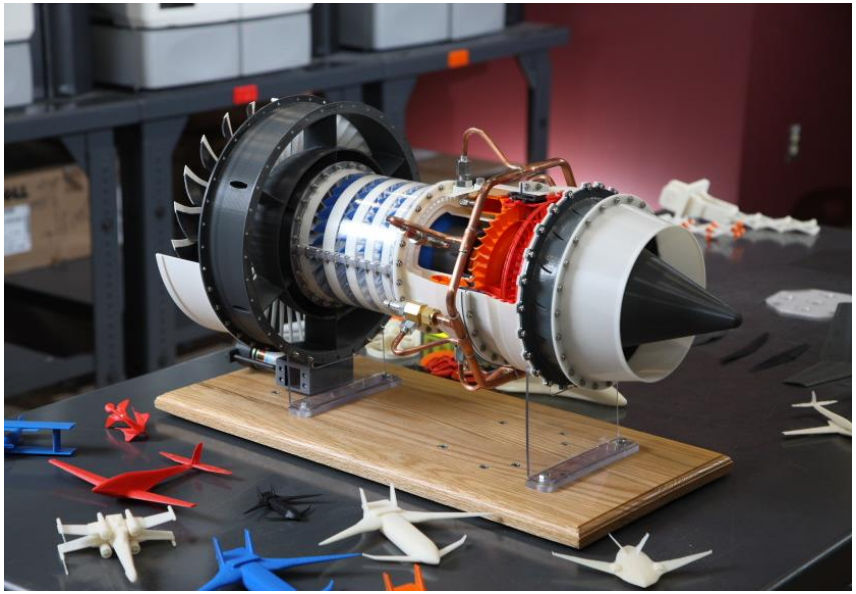
https://www.openscad.org/

Technologies of 3D printing

The RoboGen parts are 3D printed.

Types of 3D printing technologies:

- **SLS** - Selective Laser Sintering
- **FDM** - Fused Deposition Modeling
- **WDM** - Wax Deposition Modeling
- **SLA** - Stereolithography
- **Polyjet** - similar to inkjet printing
- Others



A 1/4 scale, 3D-printed jet engine replica that was able to spin at 2,000 RPM

http://www.wired.com/2012/11/3d-printed-autonomous-airplane/

What is FDM technology?

FDM - Fused Deposition Modeling

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Electronics

Electronic elements

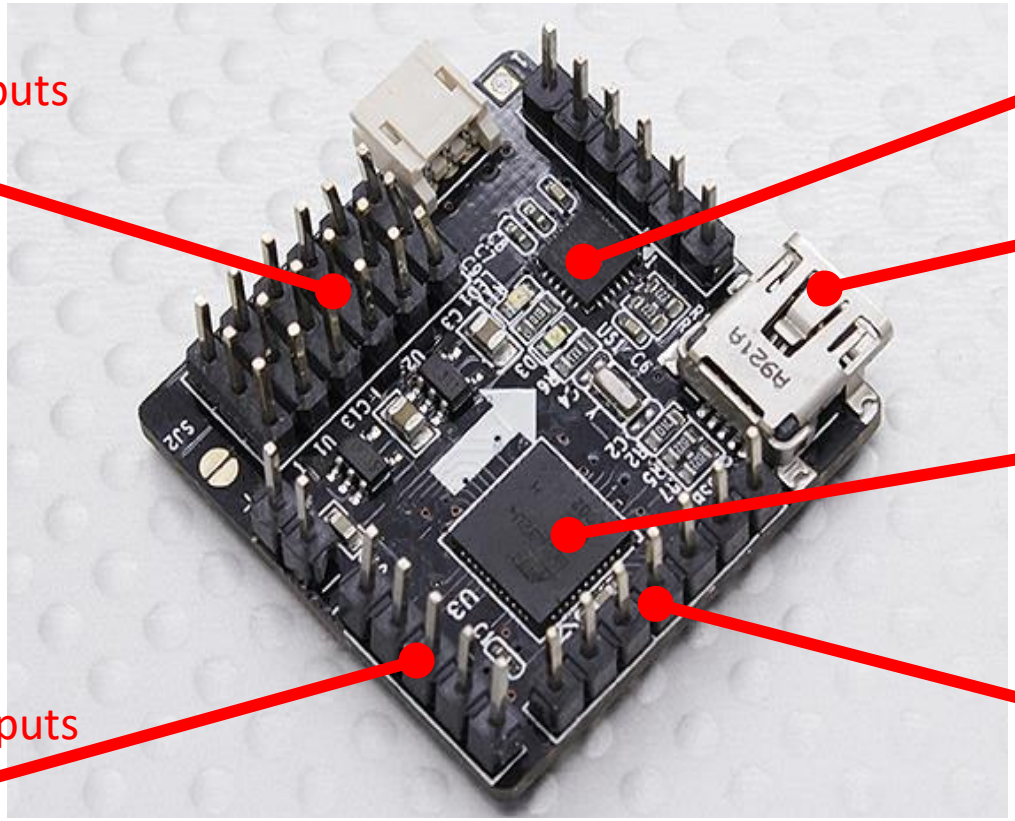
You will be given a set of:

- 1x NanoWii flight controller board (microcontroller + IMU)
- Some connecting wires
- 1x USB cable
- 8x Servo motor (integrated in active hinges)
- 4 IR sensor

The sensors are available on request.

Microcontroller

- NanoWii flight controller board (Arduino based)



6 servo outputs

On board accelerometer and gyroscope

USB

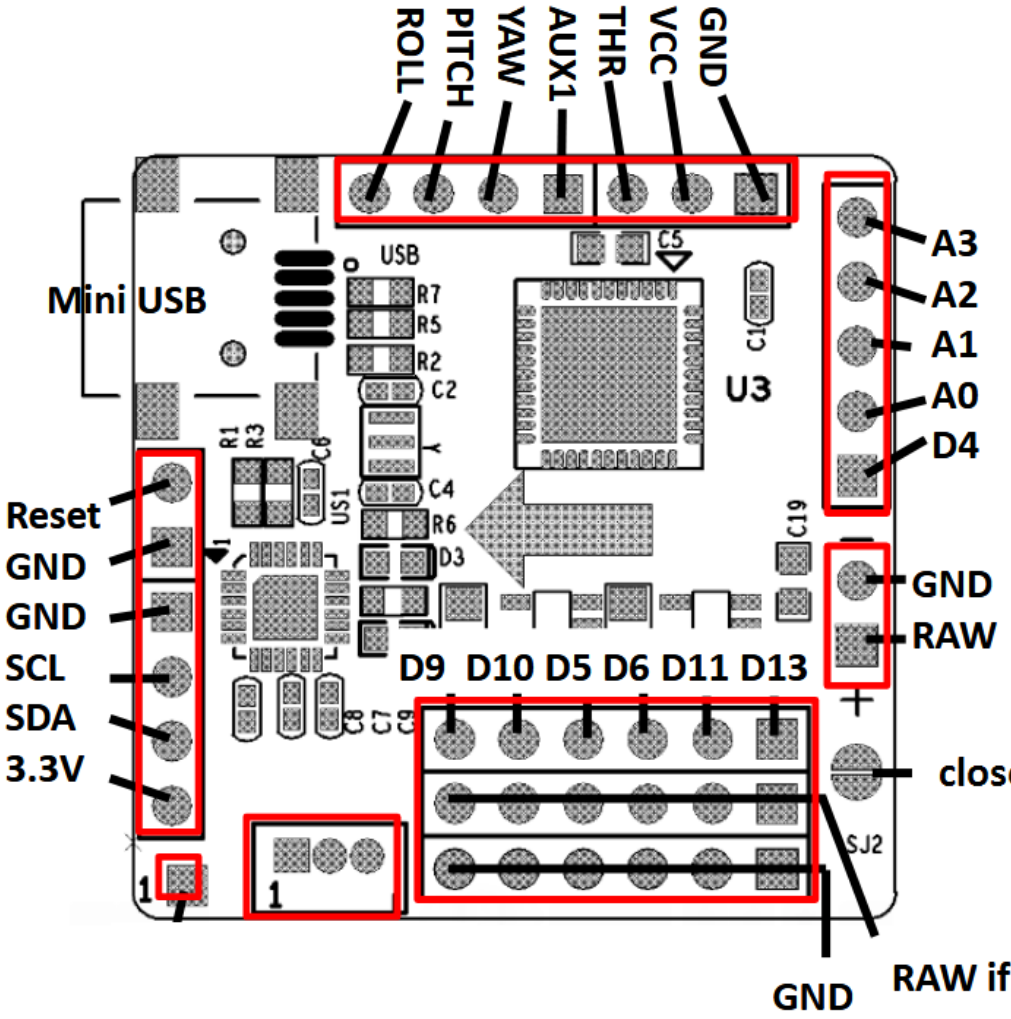
Atmel MEGA32U4 MCU (same as Arduino Leonardo)

4 Analog inputs

6 digital inputs

Dimension: 30x30x16mm
Weight : 6.5g

Microcontroller – add comments



D9,D10,D5,D6,D11,D13 – direct servo motor output connections (mind the orientation)

A0-A3 – sensor inputs

D4,ROLL,PITCH,YAW – additional digital IOs (for connecting more than 6 servo motors, for example)

SCL,SDA – I2C bus for IR distance sensor connection

GND,RAW – connect the power supply here

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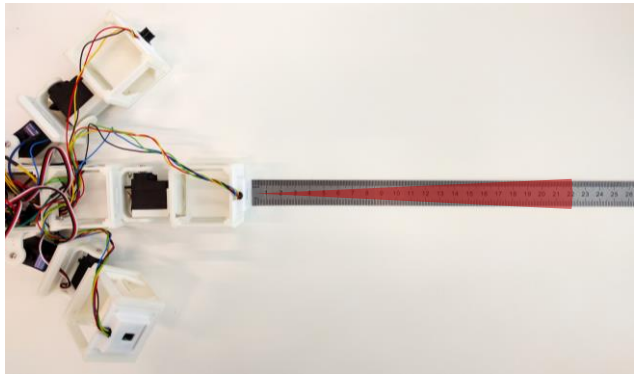
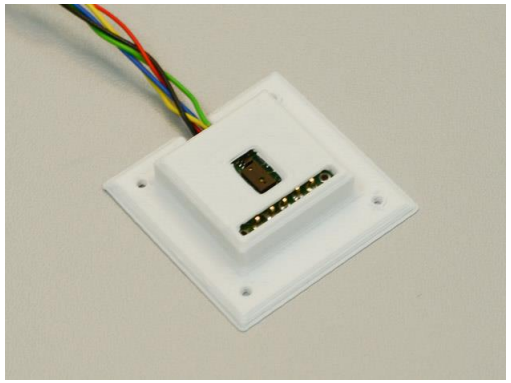
Sensors

IR distance sensor

(ST's VL6180X)





Range:
5 - 210 mm

The **Gyroscope** and **Accelerometer** MEMS sensors are combined in the MPU-6050 chip on the NanoWii flight controller board

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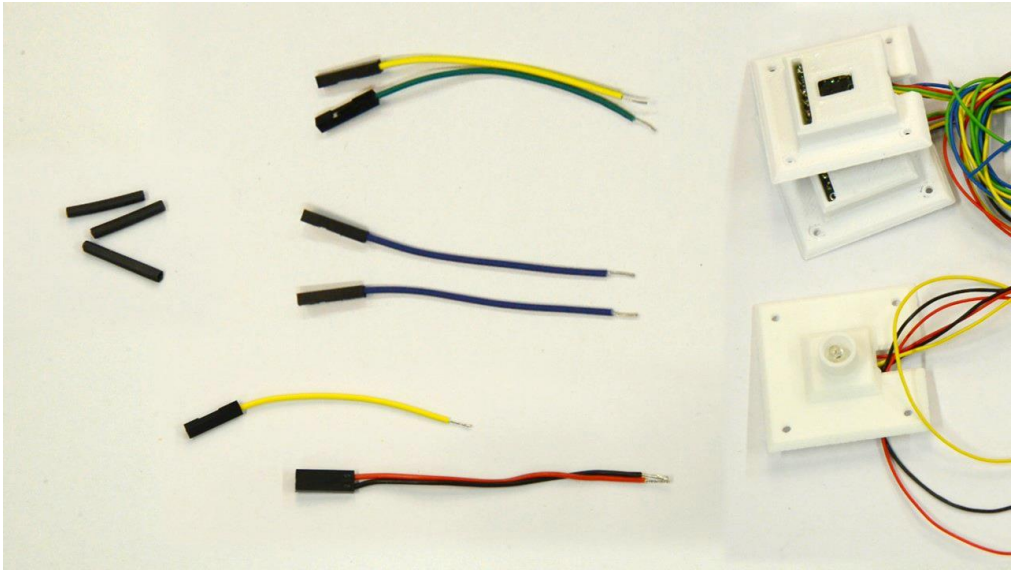
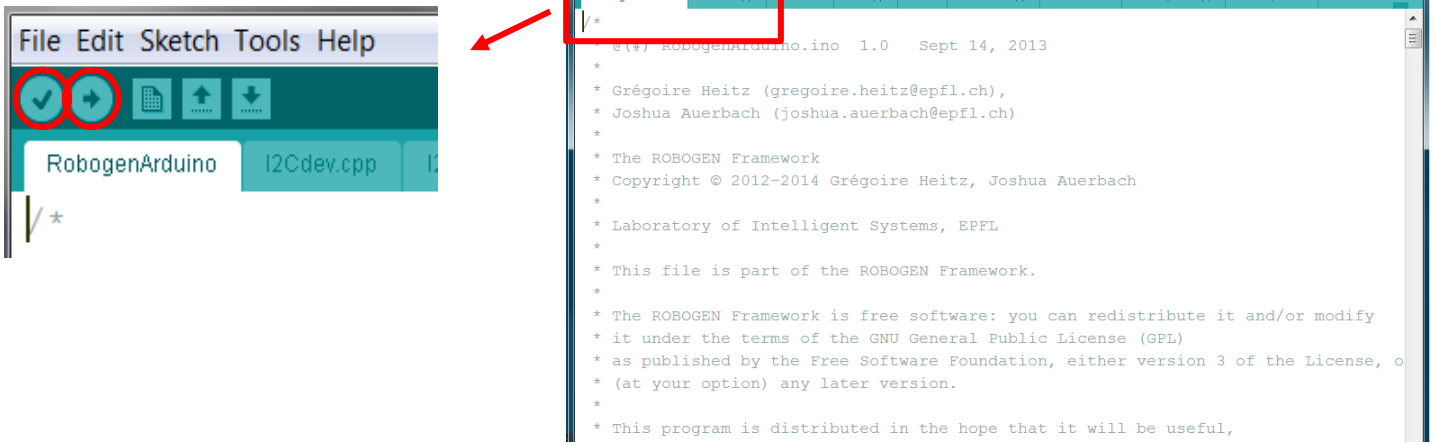
Wiring

Wires, connectors and soldering tools are available in the project room. Please, go to http://robogen.org/docs/video-tutorials/ to access a set of tutorial videos showing the wiring of the sensors or complete assembly of a robot



Programming with Arduino

You will need to download and install the Arduino IDE from www.arduino.cc



- Place your generated “NeuralNetwork.h” file to robogen/arduino/RobogenArduino/
- Open file robogen/arduino/RobogenArduino/RobogenArduino.ino
- Tools/Board : Arduino Leonardo
- Tools/Port : select the correct COM port
- Compile and upload with 

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Assembled robot

Project schedule

May 5	Intermediate Presentations
May 12	2 hours coaching session after lecture
May 19	2 hours coaching session Should have final robots fully built/assembled. Last minute help with any electronics/Arduino issues.
June 2	Final Presentations (see Moodle) Students groups must hand their final presentations in pdf or ppt format by 31st of May at 23:59 to Moodle

Begin 3D-printing and assembling

Continue working on experiments, improving robots

Note: while there will be some time in class to work on projects, you should be devoting significant time outside of class as well!

Thank you!

If you have any questions, please write to

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