Turntable demonstrator

Making instructions

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Laser cutting

First of all, to make the scale demonstrator, you need to make all the wood pieces to fasten all the different parts of the demonstrator – especially, the two robots, the scale, the turntable, and the boxes – and also to set the robot in his environment.

For these wood pieces, you will need wood planks of 5 mm thickness quite rigid, plywood, for example. Then, you will need to cut these pieces with a laser cutting machine. All cutting files are made for a machine of dimensions 600x300 mm, as the TROTEC Speedy 100 (https://www.troteclaser.com/fr/machines-laser/machines-gravure-laser-speedy/).

Seven types of pieces are necessary:

- 2 niryo stand, to fasten the robots

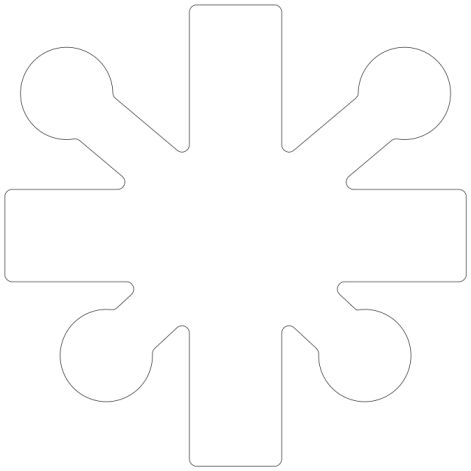


figure 1: niryo_stand.dxf

dimensions: 250x250x5 mm

- 1 centre, to set the scale

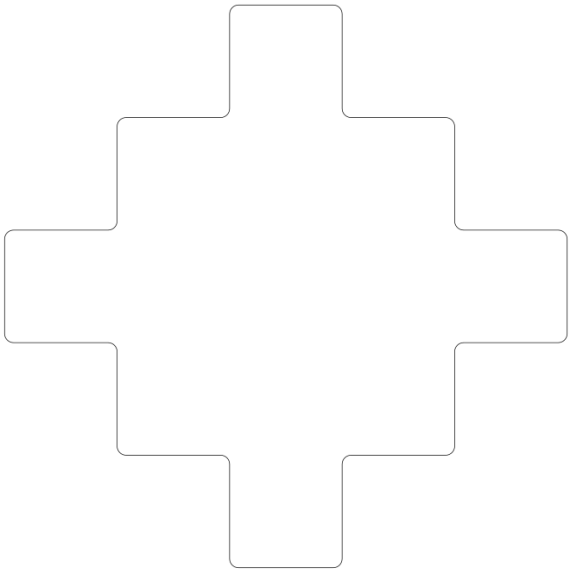


figure 2: centre.dxf

dimensions: 250x250x5 mm

- 1 turntable stand, to set the turntable

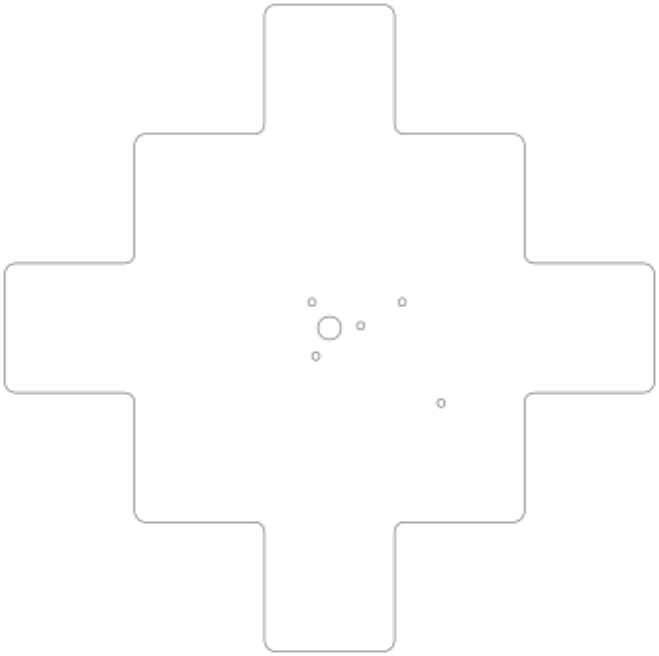


figure 3: turntable_stand.dxf

dimensions: 250x250x5 mm

- 1 boxes stand, to set the reception's boxes

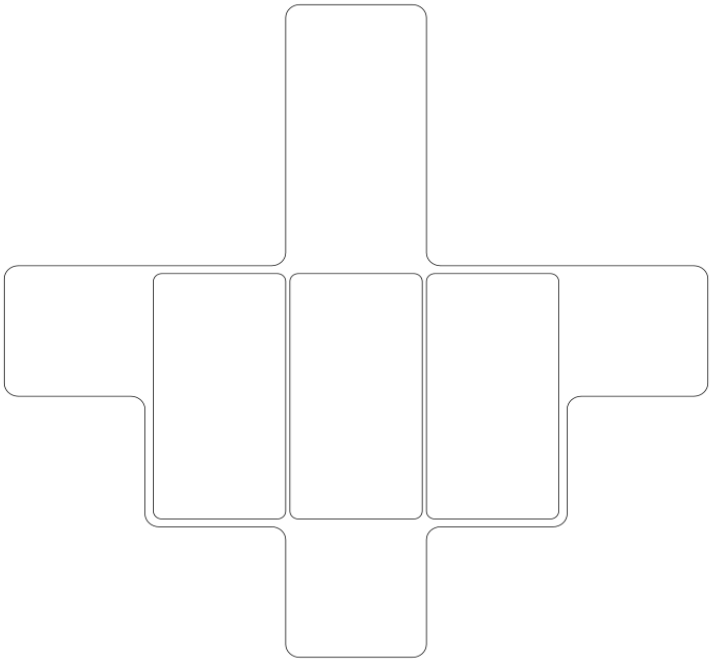


figure 4: boxes_stand.dxf

dimensions: 250x250x5 mm

- 4 T blocks, to link everything

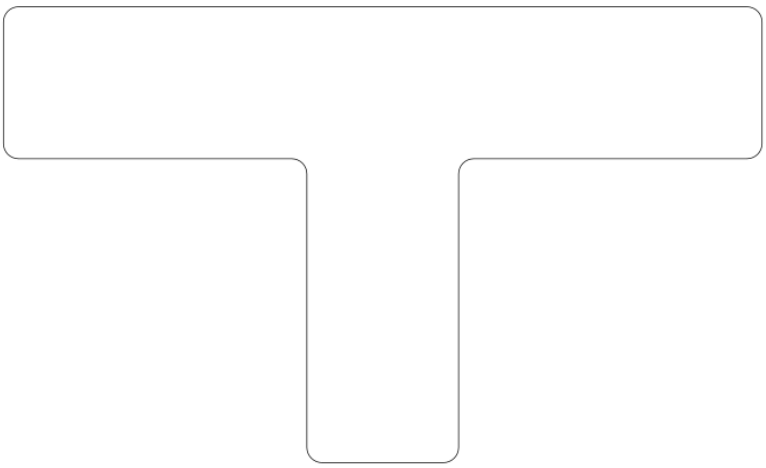


figure 5: T_block.dxf

dimensions: 250x150x5 mm

- Upper turntable

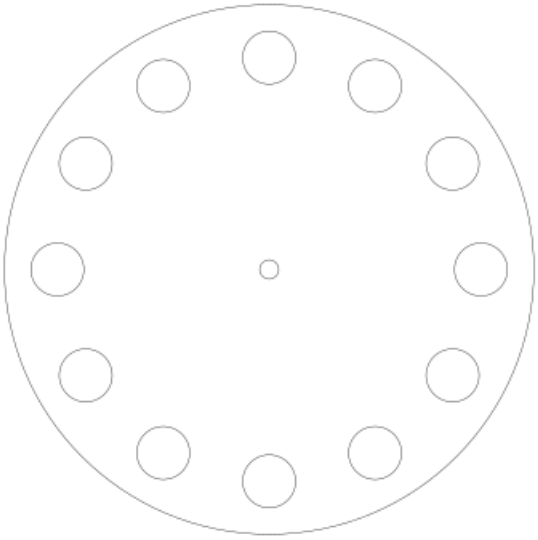


figure 6: upper_turntable.dxf

dimensions: 250x250x5 mm

- Bottom turntable

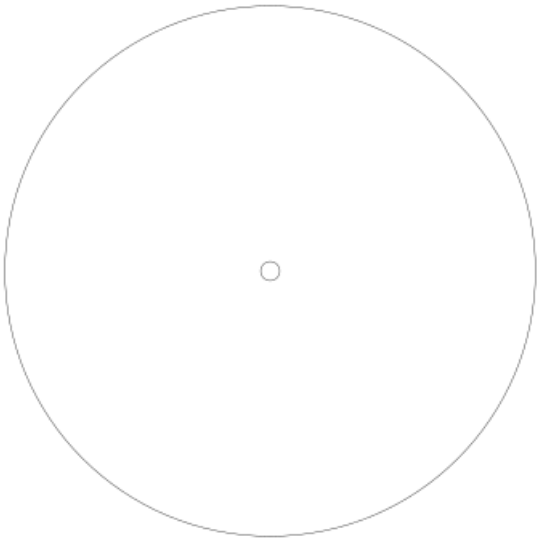


figure 7: bottom_turntable.dxf

dimensions: 250x250x5 mm

To cut these pieces, you will need five planks of 600x300 mm, one for the two niryo stand, one for the centre and the turntable stand, one for the boxes stand and the three T blocks, and one for the last T blocks.

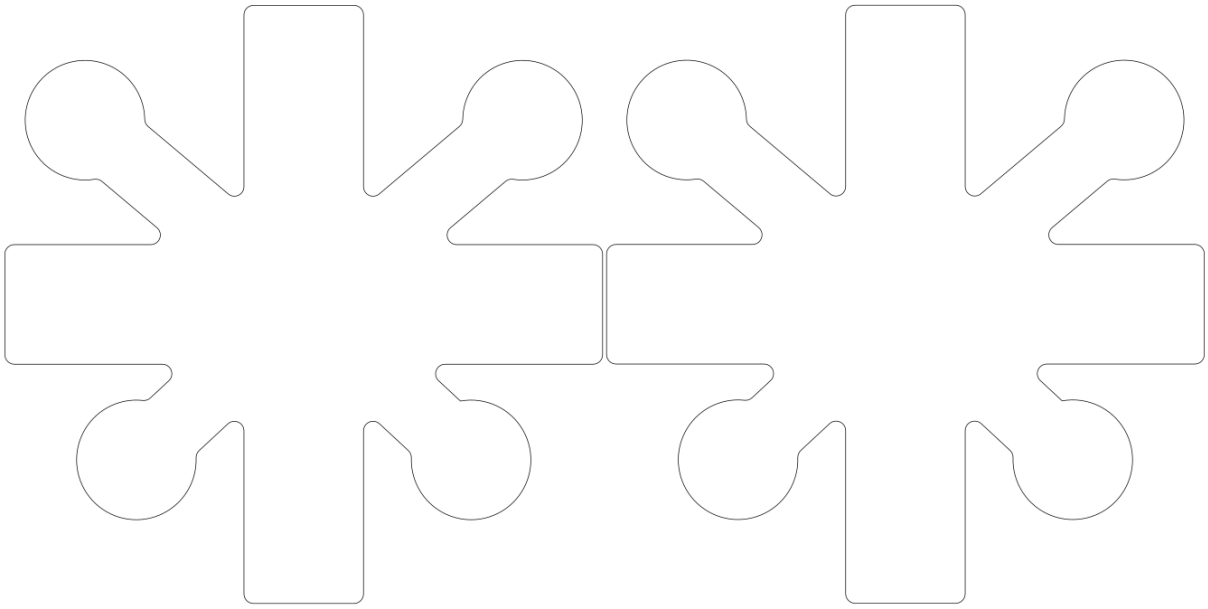


figure 8: turntable1.svg

dimensions: 501.66x150 mm

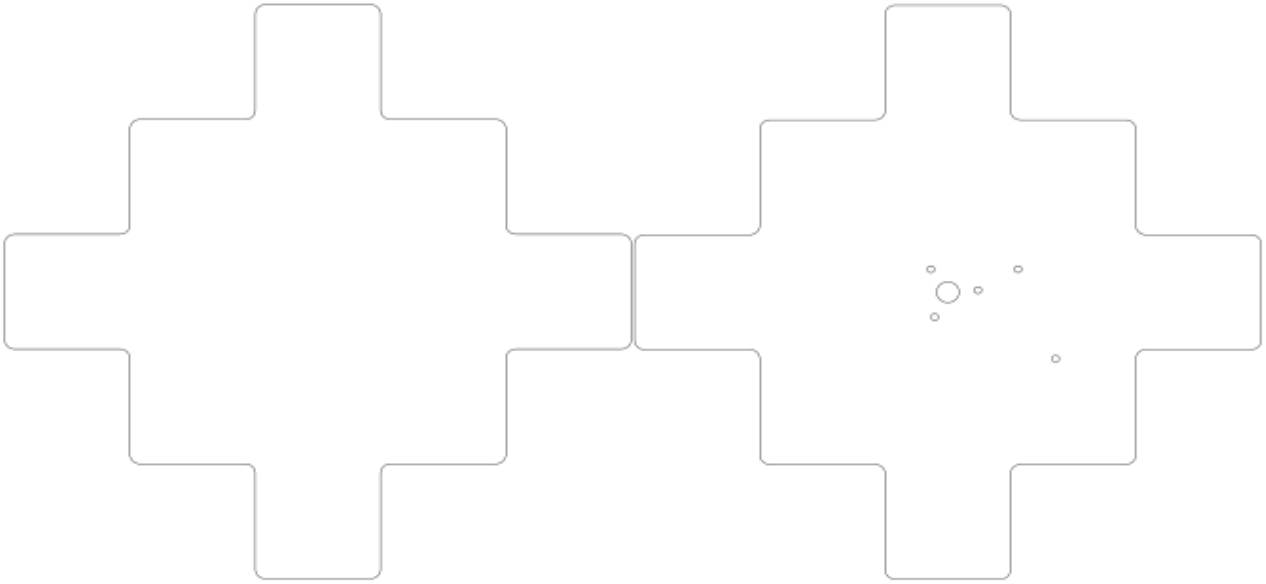


figure 9: turntable2.svg

dimensions: 502.34x150 mm

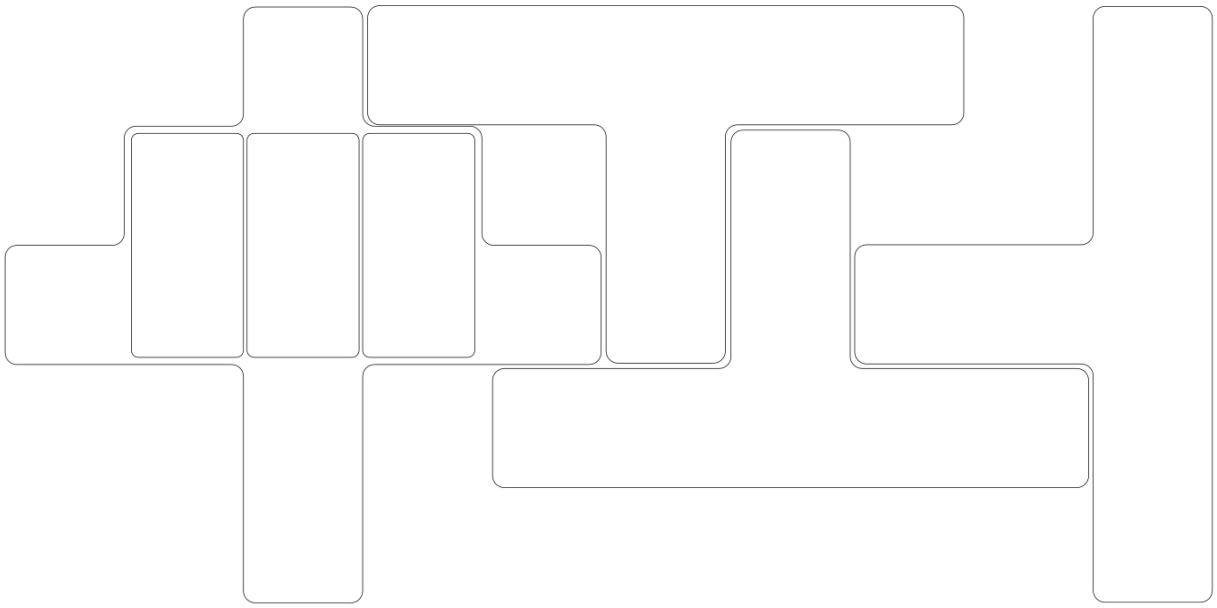


figure 10: turntable3.svg

dimensions: 506.36x250 mm

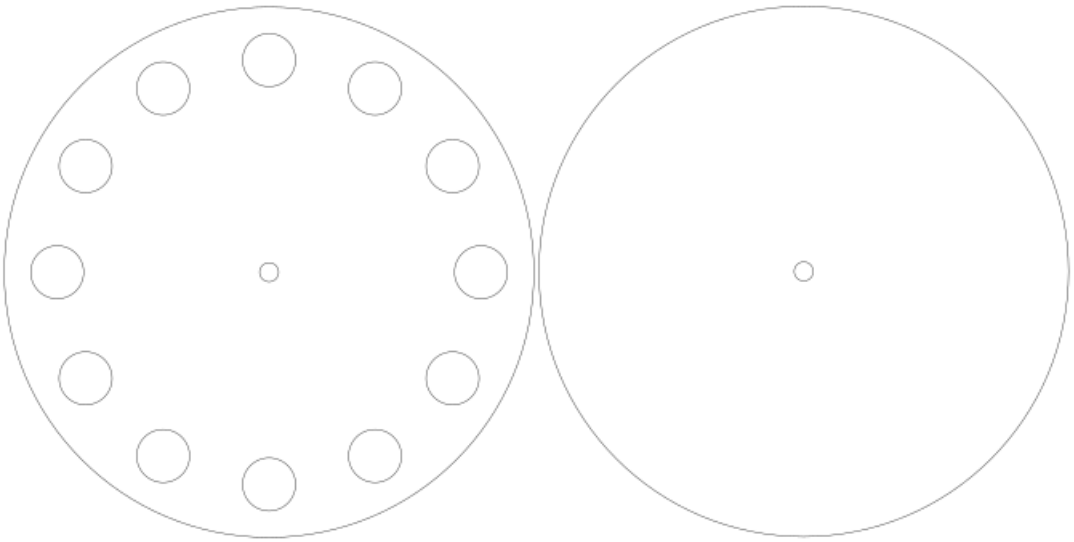


figure 11: turntable4.svg

dimensions: 502.34x250 mm

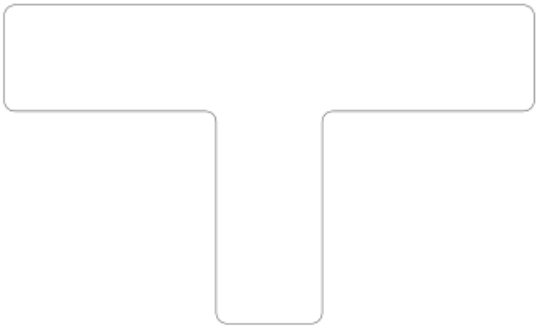


figure 12: turntable5.svg

dimensions: 250x250 mm

3D printing

You will need to print different 3D pieces:

- 3 reception’s boxes

figure 13: box.stl

dimensions: 94x47x73 mm

- 1 16 teeth gear

figure 14: Spur Gear (16 teeth).stl

dimensions: 54x54x12.7 mm

- 1 8 teeth gear

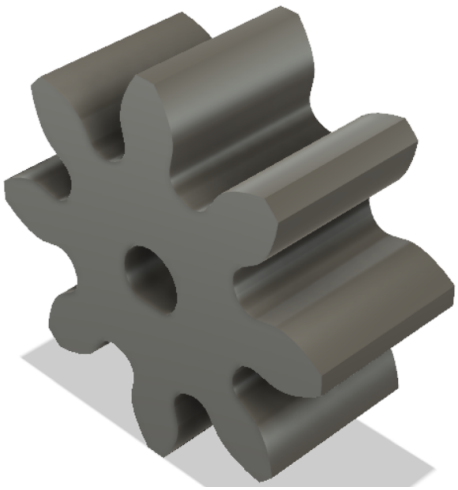


figure 15: Spur Gear (8 teeth).stl

dimensions: 30x30x12.7 mm

- 12 right magnet fastener

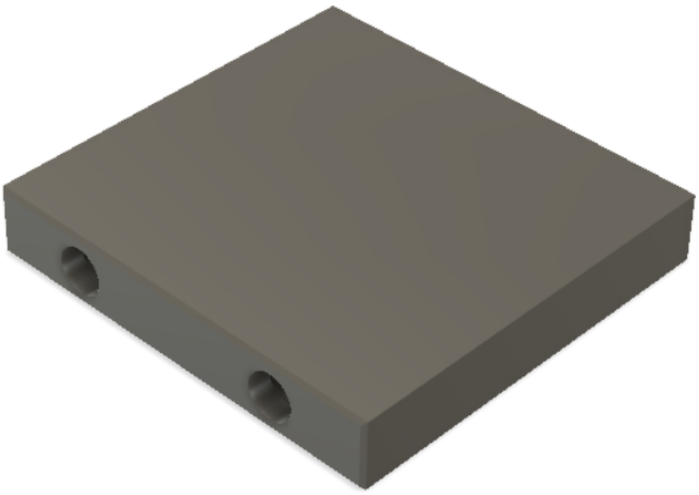


figure 16: magnet_fastener_right.stl

dimensions: 63.071x58x9 mm

- 12 left magnet fastener

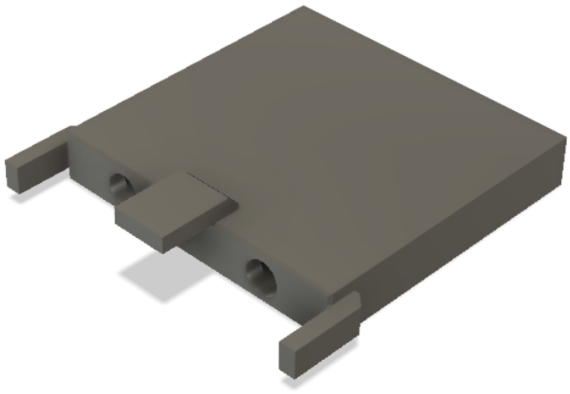


figure 17: magnet_fastener_left.stl

dimensions: 63.071x58.034x12 mm

- 1 bottom button’s block

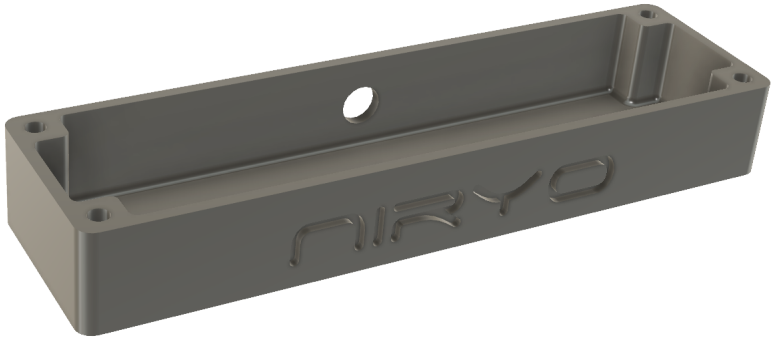


figure 18: bottom_button.stl

dimensions: 180x50x25 mm

- 1 upper button’s block

figure 19: upper_button.stl

dimensions: 180x50x15 mm

- 1 turntable stand

figure 20: turntable_stand.stl

dimensions: 150x150x65 mm

- 1 nut stand

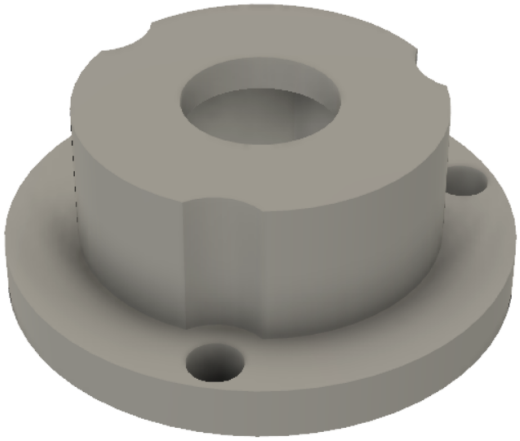


figure 21: nut_fastener.stl

dimensions: 28x28x11 mm

All 3D pieces need to be printed with these printer characteristics:

- Nozzle size: 0.4 mm
- Layer's thickness: 0.2 mm
- Filling: 15/20 %

Demonstrator assembly

When all the pieces are cut or printed, you can start the assembly of the demonstrator.

Begin by introducing the little round magnet in the hole provided for this purpose in the pieces “magnet_fastener_right” and “magnet_fastener_left”.

Then, you can assemble the different pieces of the demonstrator following this scheme:

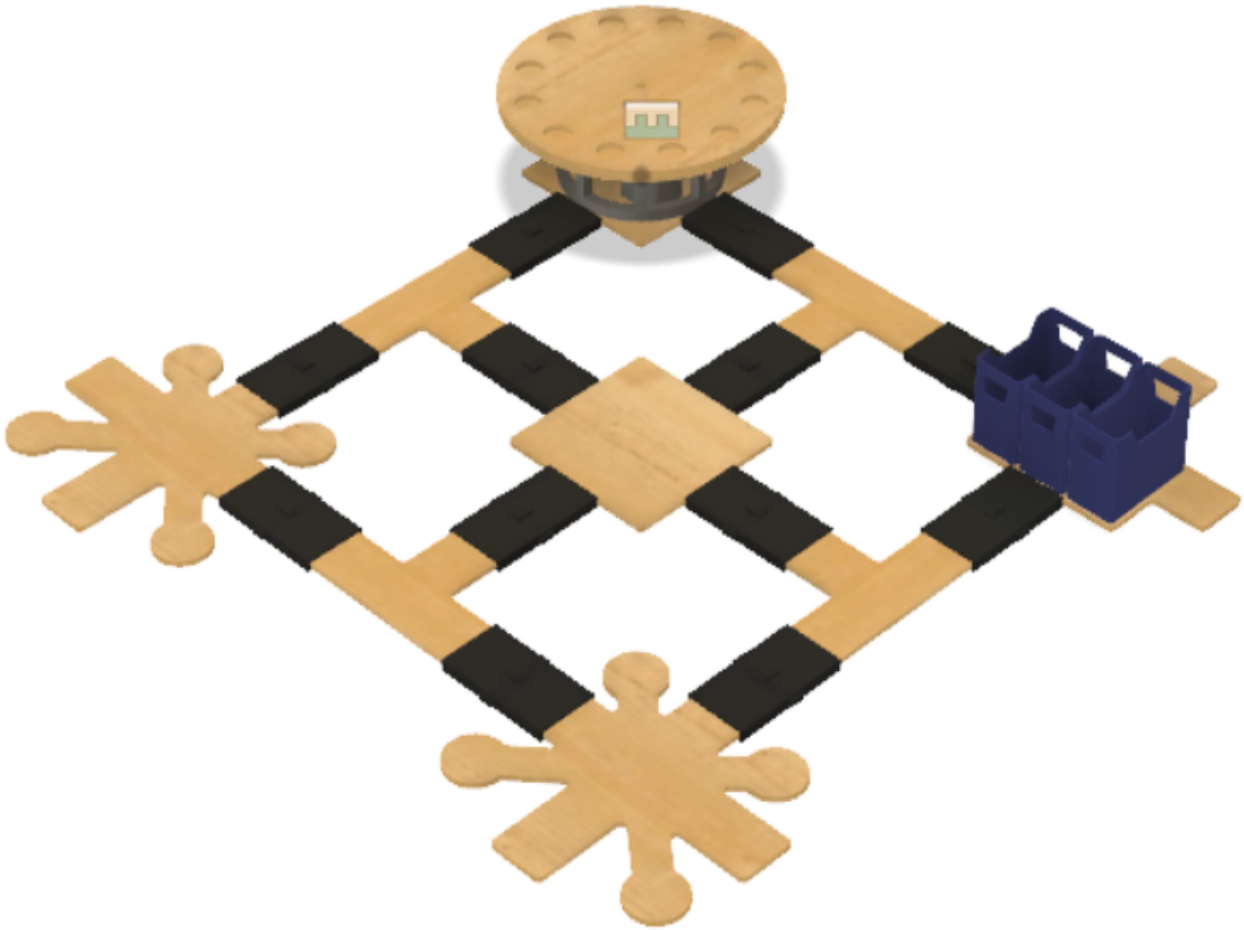


figure 22: turntable assembly

dimensions: 762x762x77 mm

Robots

The robots need to be set on their stand, with the back part (the one with connectors) on the opposite side of the shelves and boxes.

Be sure to bolt the robot’s pads with the hand bolts so that the robots are securely fastened to their stand.

Expanders I2C

Three I2C expanders are needed to make the demonstrator work. There are used to reduce the number of wires and pins used by the Arduino board.

The first one is used for the buttons. The three jumpers (in yellow on the picture) have to be positioned like this, to define the address at 0x20 (in hexadecimal).

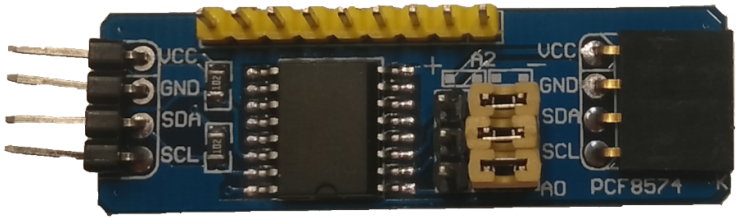


figure 23: expander I2C, adresse 0x20

The second one is used for the first robot. The three jumpers (in yellow on the picture) have to be positioned like this, to define the address at 0x21 (in hexadecimal).

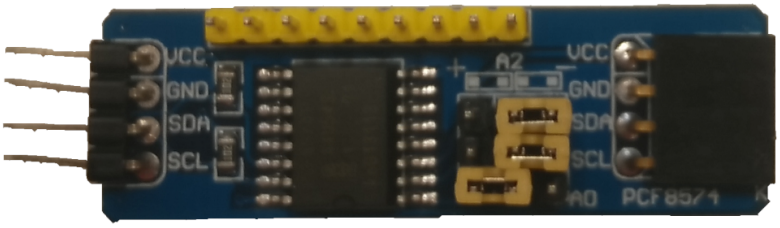


figure 24: expander I2C, adresse 0x21

The third and last one is used for the second robot. The three jumpers (in yellow on the picture) have to be positioned like this, to define the address at 0x22 (in hexadecimal).

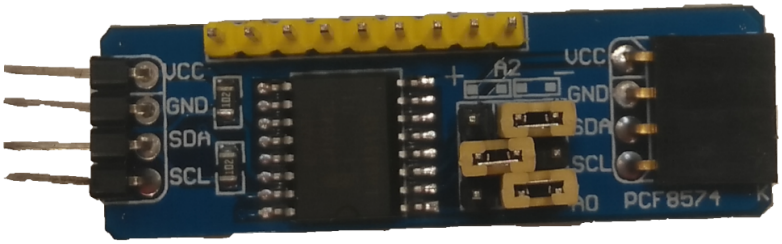


Figure 25: expander I2C, adresse 0x22

You will find how to wire these expanders in the wiring part later in the manual.

Buttons

The four push buttons need to placed in the button's block, one button peer hole. Then the button's block can be close thanks to the four M5 screws of 25 mm long. The wiring of these buttons will be detailed in the wiring part later.

Scale

First stage

Glue the rubber adhesive pads under the first stage of the scale. Then set the Arduino board on the first stage and fasten it by putting screws below the stage, the braces between the stage and the board, and with screws above the board. Then set the push button in the rectangle marked, fasten it by putting a screw below the stage and a nut above the button. Finally, put three screws below at the extremities of the stage and three braces above.

Second stage

Put the weight module above the second stage in the rectangle marked and fasten it with a screw above and a nut below. Then put a screw below the stage, an acrylic spacer above and add the rheostatic sensor. Then put the four screws to fasten the LCD screen below the stage, the four braces above and finally the screen above, fasten it with four screws above.

Put the stage above the big braces and fasten them with three screws.

Add an acrylic spacer above the rheostatic sensor, and then add the transparent stage and fasten it with a screw above.

The scale wiring will be detailed in the wiring section later.

Boxes

The boxes need to set on the boxes stand.

Turntable

First glue the turntable stand 3D printed on the wood turntable stand. Then put the M8 nut in its stand and mind the orientation.

Figure 26: nut and nut stand assembly

Then, fasten the nut stand to the turntable stand with three M3 screws of 10 mm. Put the step by step motor next to the nut and fasten it with two M3 screws of 50 mm. You can then put the 8 teeth gear on the motor axis ans stick the 16 teeth gear to the bottom part of the turntable. Then stick the two parts of the turntable to finish the turntable. After that, put the four bearings in the four holes made for that purpose on the 3D turntable stand, and fasten them with four M3 screws of 16 mm. Then put the turntable on its stand and make sure the two gears fit well. Finally, put the M8 screw in the hole and fasten everything, make sure that the turntable is on the bearings.

Wiring

Expanders I2C

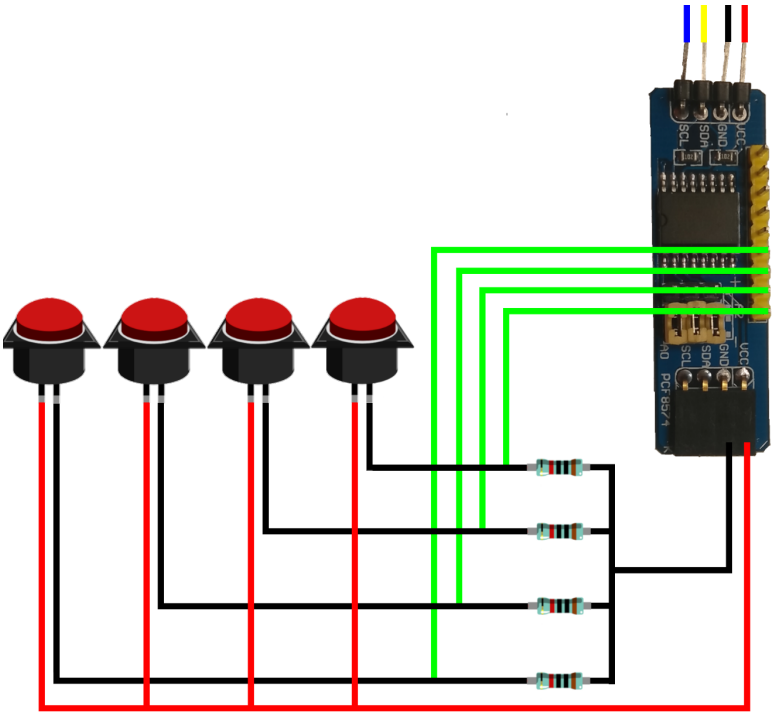


figure 27: button's expander I2C wiring

Inside the button's block, you can wire the I2C expander like above. Then take the four wires (VCC, GND, SDA, SCL) out by the button's block hole. Then they will be plug to, the Arduino board.

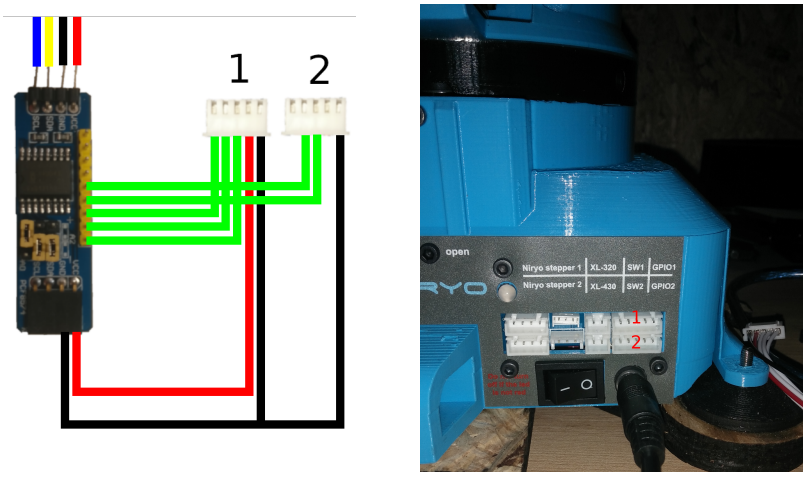


Figure 28: wiring of the I2C expander of the robot 1

The second I2C expander need to be connected to the robot 1 as above. The four wires (VCC, GND, SDA, SCL) will then be plug to the Arduino board.

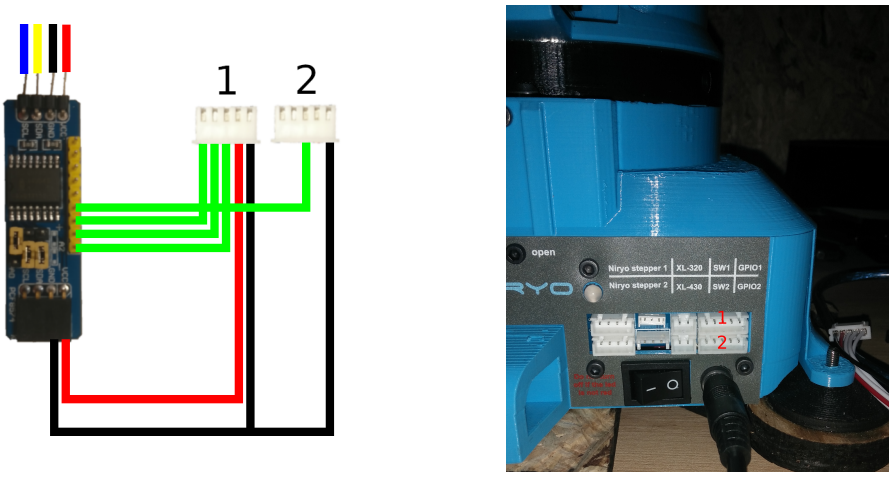
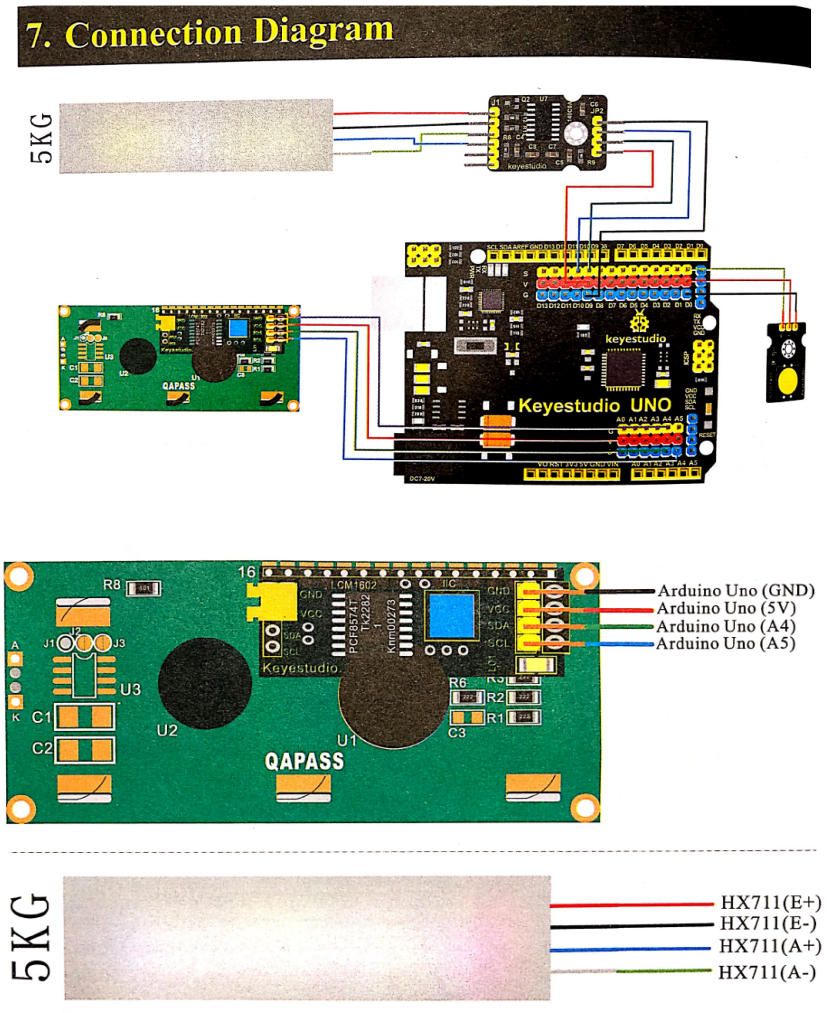


figure 29: wiring of the I2C expander of the robot 2

Finally, the third I2C expander need to be connected to the robot 2 as above. The four wires (VCC, GND, SDA, SCL) will then be plug to the Arduino board.

Scale



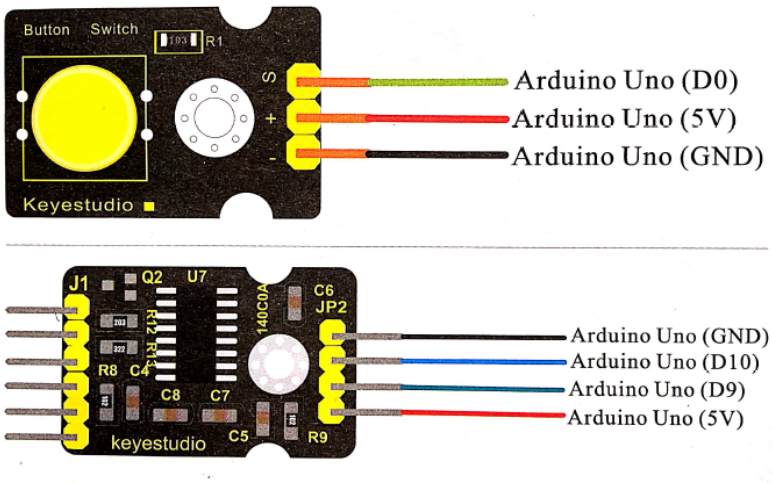


figure 30: scale's wiring

The scale's wiring need to be done as the figure above. The scale as its own Arduino Uno board, you have to wire the cable on this one. The board will then be connected to the Arduino Mega board.

EasyDriver

To make the step by step motor work, we need a motor driver. In our case, we use an EasyDriver. Below you can see how you need to wire it to the Arduino board and to the motor:

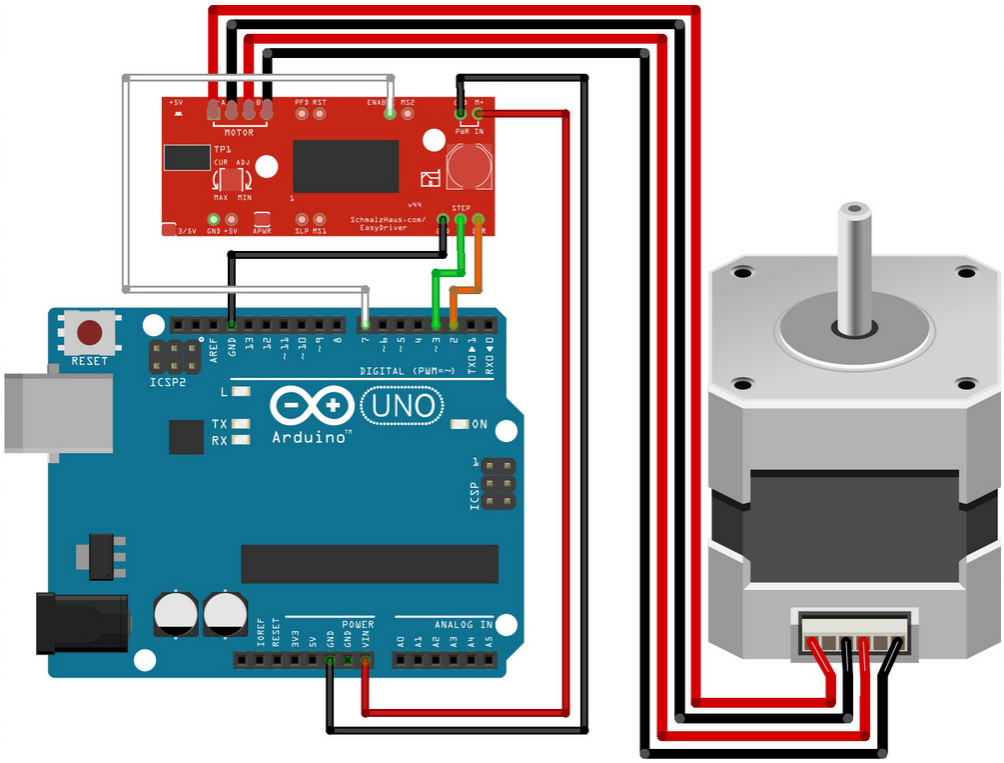


figure 31: Motor driver wiring

Note that on the picture it is wired to An Arduino UNO, in our case we use an Arduino Mega but it is the same wiring.

Arduino

To finish the demonstrator’s wiring, wire the Arduino Mega board and the Bluetooth module as below.

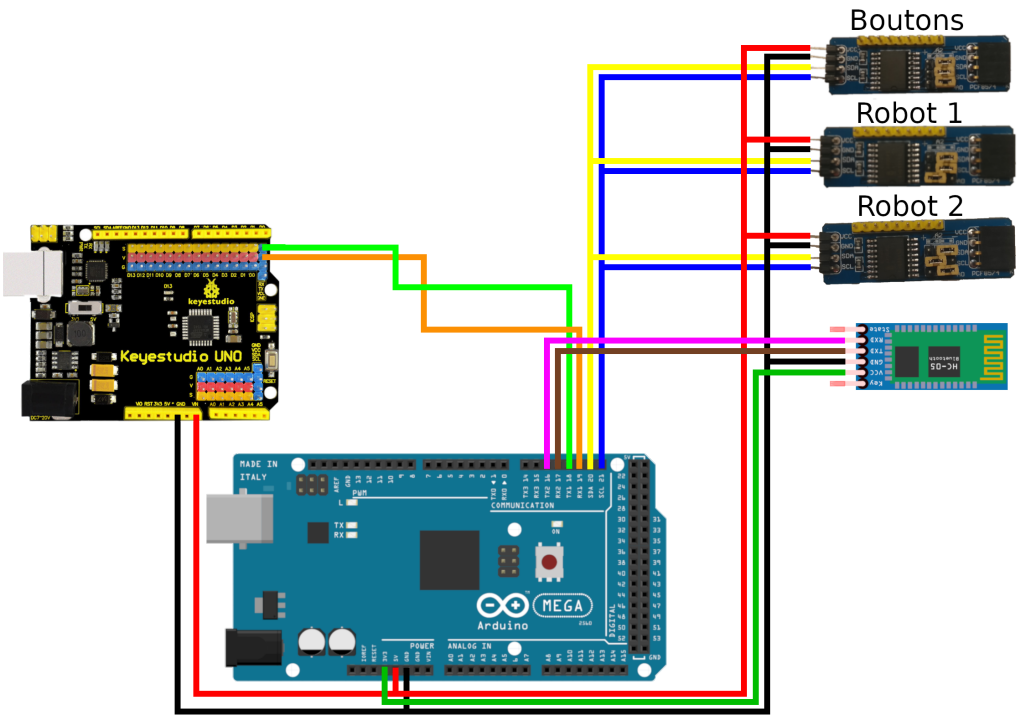


Figure 32: Arduino board’s wiring