MOVEO

ECAM STRASBOURG EUROPE

USER GUIDE

TECHNICAL PROJECT SMART FACTORY

ASSEMBLY AND USAGE MANUAL

INDEX

About the Moveo Robot

This user manual is inspired by the original BCN3D Moveo user manual available on GitHub available here: https://github.com/BCN3D/BCN3D-Moveo

The robot is fully open source and has been modified from its original form, each piece come from 3D printing and has been assembled using usual fasteners. All the informations you need is available in the bill of material of the robot.

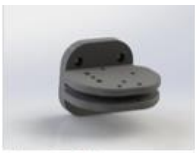
This user guide demonstrates how to assemble the robot and wire everything properly. Since the robot should already be assembled, this guide is useful during the maintenance part or if any modification is applied on the robot.

Bill of material

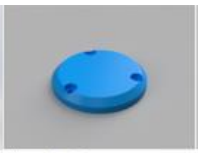
		Part	Quantity	Reference	ID
Components	Bearings	8mm x 22mm x 7mm Bearing	10	619-0036	1
		5mm x 16mm x 5mm Bearing	8	408-9754	2
		4mm x 13mm x 5mm Bearing	9	618-9890	3
		3mm x 10mm x 4mm Bearing	3	747-721	4
	Rods	8mm x 40mm Smooth Rod	1	fourni	5
		8mm x 140mm Smooth Rod	1	fourni	6
		8mm x 115mm Smooth Rod	1	fourni	7
		8mm x 80mm Smooth Rod	1	fourni	8
	Belts	45,5cm T5 Belt	4	1003937	9
	Pulleys	T5 Pulley 8mm Bore	3	286-5758	10
		T5 Pulley 5mm Bore	2	744-946	11
Fasteners	Screws	M3 x 8 mm	1	280-997	12
		M3 x 10 mm	1	660-4636	13
		M3 x 12 mm	1	187-1229	14
		M3 x 16 mm	1	281-013	15
		M3 x 20 mm	1	483-8196	16
		M3 x 25 mm	1	293-325	17
		M3 x 35 mm	1	1809206	18
		M3 x 40 mm	1	5427621	19
		M4 x 16 mm	1	281-041	20
		M4 x 20 mm	1	290-102	21
		M4 x 25 mm	1	281-057	22
		M4 x 30 mm	1	290-118	23
		M4 x 40 mm	1	293-347	24
		M4 x 45 mm	1	5427666	25
		M4 x 60 mm	1	1809225	26
		M5 x 14 mm	1	1808461	27
		M5 x 20 mm	1	1809234	28
		M5 x 30 mm	1	483-9997	29
		M5 x 40 mm	1	293-353	30
		M8 x 65mm	1	124-7277	31
	Nuts	M4 Nut	1	189-579	32
		M3 Nut	1	560-293	33
		M4 Locknut	1	524-304	34
		M5 Locknut	1	524-310	35
		M8 locknut	1	521-951	36
	Washers	M3 Washer	1	814628	37
	Inserts	M4 Inserts	1	278-556	38

Electronics	Motors	Nema 23 Motor	2	1597326	39
		Nema 17 5:1 Geared Motor	1	2148836	40
		Nema 17 Motor	1	535-0467	41
		Nema 17 Long Motor	1	535-0401	42
		Nema 14 Motor	1	2142562	43
		Beam coupling	1	186-4100	44
		Servo Motor	2	1611552	45
	Controller	Arduino Mega 2560	2	fourni	46
		24V 240W Power Supply 12,5 A	1	1783164	47
		Makeblock Drivers motor 130599	6	1549380	48
		Power supply cable	1	626-6688	49
		USB cable	2	815-8450	50
		Câble MAKERFactory Arduino Mâle - Femelle	6	1972205	51
		Power converter 12V/24V - 240W	1	1666859	52
		Fan	2	787-8948	53
		Screen raspad Sunflower	1	SF-RASPAD	54
		Raspberry Pi	1	fourni	55
		Breadboard	2	1516559	56
	Other	Cable gaine thermoretractable	5	1571483	57

Printed pieces		Gripper doubled top plate	1		58
		Elbow shaft cover	2		59
		Wrist back cover	1		60
		Wrist shaft cover	2		61
		Shoulder shaft cover	2		62
		Servo Gear B	2		63
		Servo Gear A	2		64
		Pivot Arm B	4		65
		Gripper left	2		66
		Gripper right	2		67
		Gripper bottom plate	2		68
		Elbow belt tensioner	1		69
		Wrist belt tensioner	1		70
		Shoulder belt tensioner left	1		71
		Shoulder belt tensioner right	1		72
		Wrist base	1		73
		Cylinder	4		74
		Shoulder base	1		75
		Wrist half	1		76
		Elbow base	1		77
		Elbow joint half 1	1		78
		Elbow joint half 2	1		79
		Shoulder joint	1		80
		Base Motor Mount	1		81
		Shoulder joint	1		82
		Rotary Base	1		83
		Rotary Plate	1		84
		Driver box	1		85
		Driver box drawer	1		86
		Control panel support	1		87

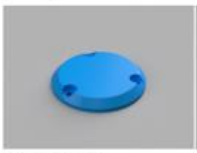


Gripper Top Plate
Quantity: 1

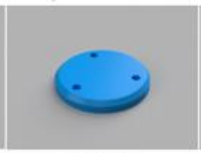


Elbow Shaft Cover
Quantity: 2

Wrist Back Cover
Quantity: 1



Wrist Shaft Cover
Quantity: 2



Shoulder Shaft Cover
Quantity: 2

Servo Gear B
Quantity: 1

Elbow Belt Tensioner
Quantity: 1

Wrist Belt Tensioner
Quantity: 1

Shoulder Belt Tensioner Left
Quantity: 1

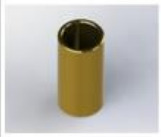
Shoulder Belt Tensioner Right
Quantity: 1

Servo Gear A
Quantity: 1

Pivot Arm B
Quantity: 2

Gripper Right
Quantity: 1

Wrist Base
Quantity: 1



Spacer M8x20 mm
Quantity: 1

Gripper Left
Quantity: 1

Gripper Bottom Plate
Quantity: 1

Wrist Half
Quantity: 1

Cylinder
Quantity: 2

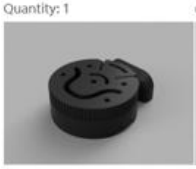
Shoulder Base
Quantity: 1

Wrist Half
Quantity: 1

Elbow Base
Quantity: 1

Elbow Joint Half
Quantity: 1

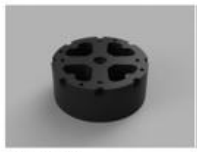
Elbow Joint Half
Quantity: 1



Shoulder Joint
Quantity: 1

Base Motor Mount
Quantity: 1

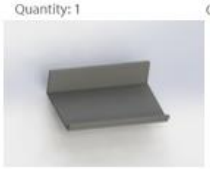
Shoulder Joint
Quantity: 1



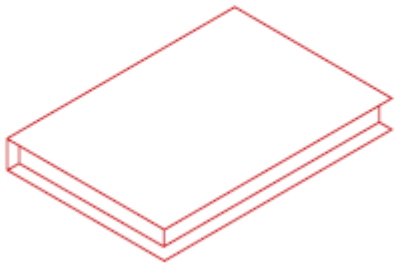
Rotary Base
Quantity: 1

Rotary Plate
Quantity: 1

Spacer M5x10 mm
Quantity: 8



Screen support
Quantity: 1



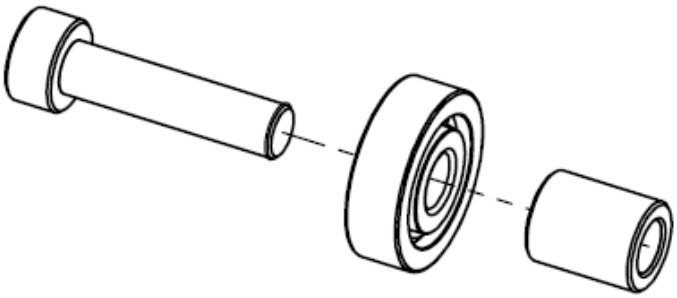
Assembly manual

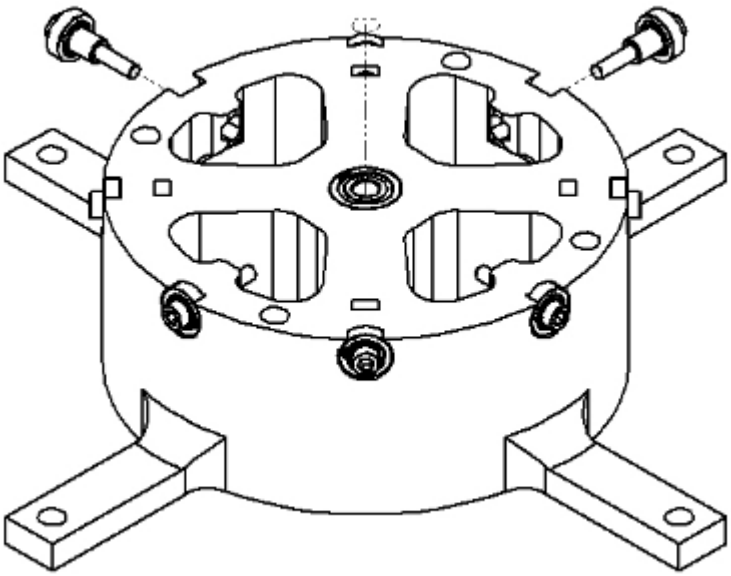
MODULE 1: ROTARY BASE

Step 1: Rotary base assembly

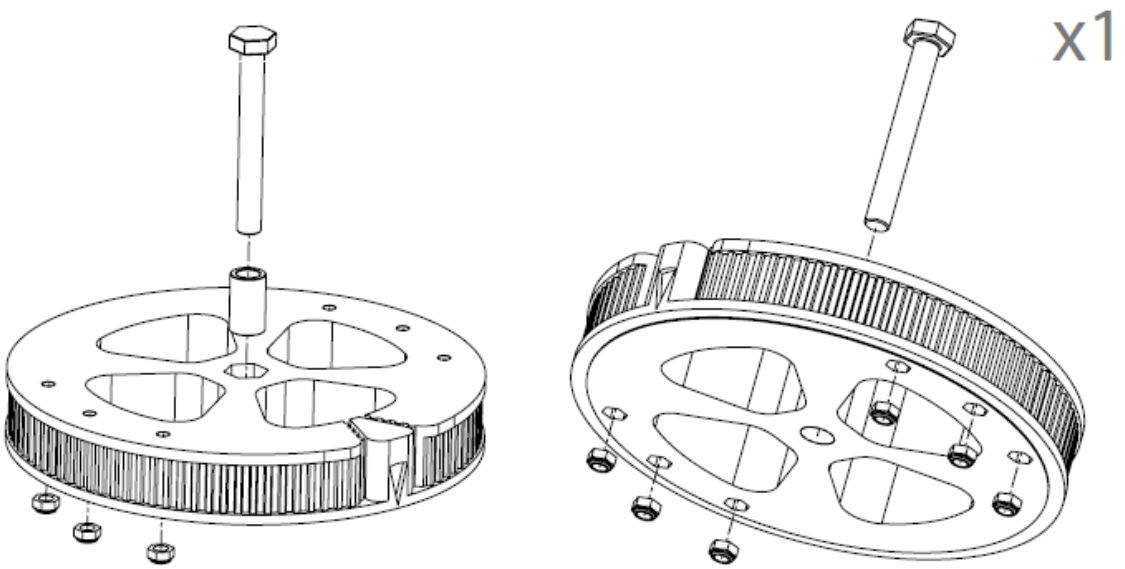
BOM ID	Description	Qty
1	Bearing 8 mm x 22 mm x 7 mm	2
83	Rotary Base	1
28	Screw M5 x 20 mm	8
2	Bearing 5mm x 16mm x 5mm	8
87	Spacer 8 x 10 mm	8

x8

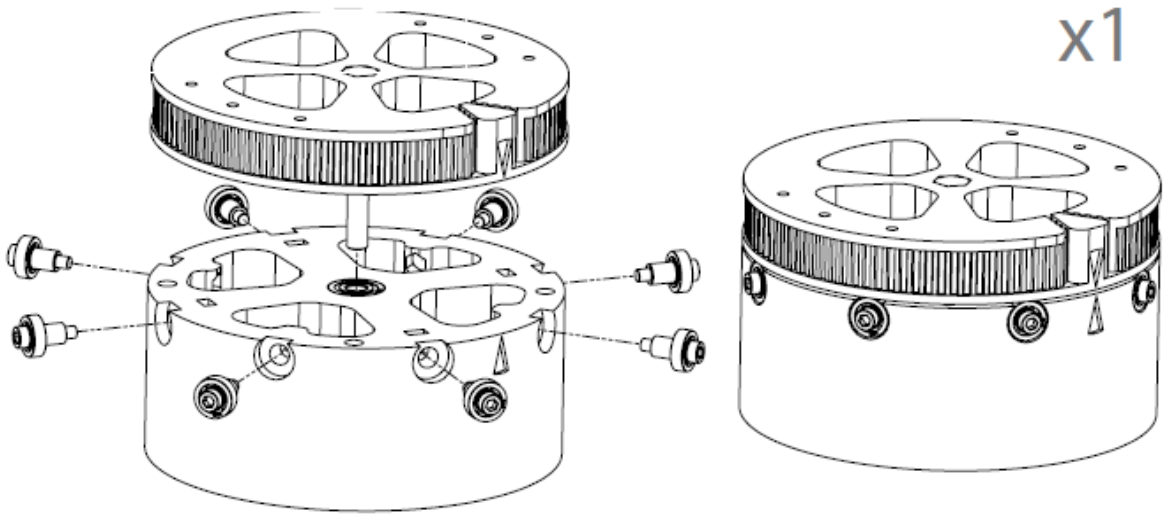




Step 2: Rotary plate assembly



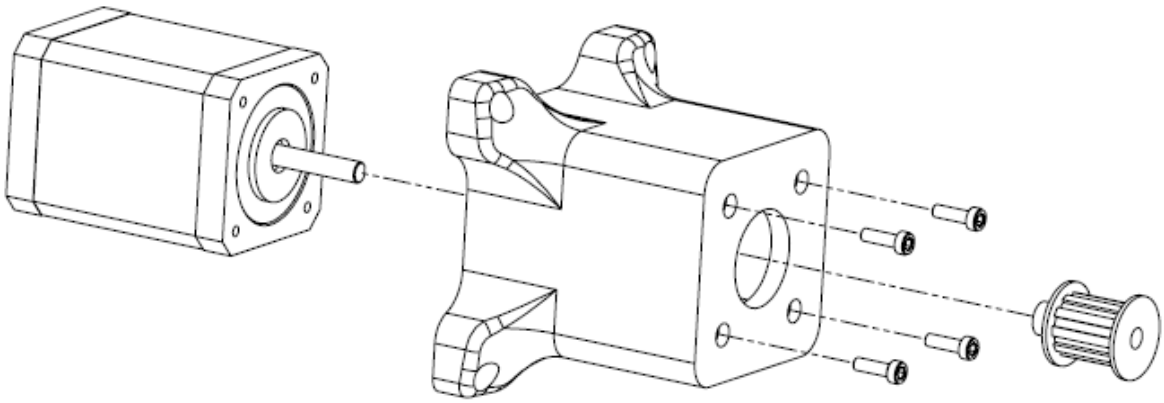
BOM ID	Description	Qty
31	Screw M8 x 65 mm	1
34	M4 Locknut	6
88	Spacer M8 x 20 mm	1
84	Rotary Plate	1



BOM ID	Description	Qty
/	Rotary plate assembly	1
/	Rotary base assembly	1

Step 3: Base motor assembly

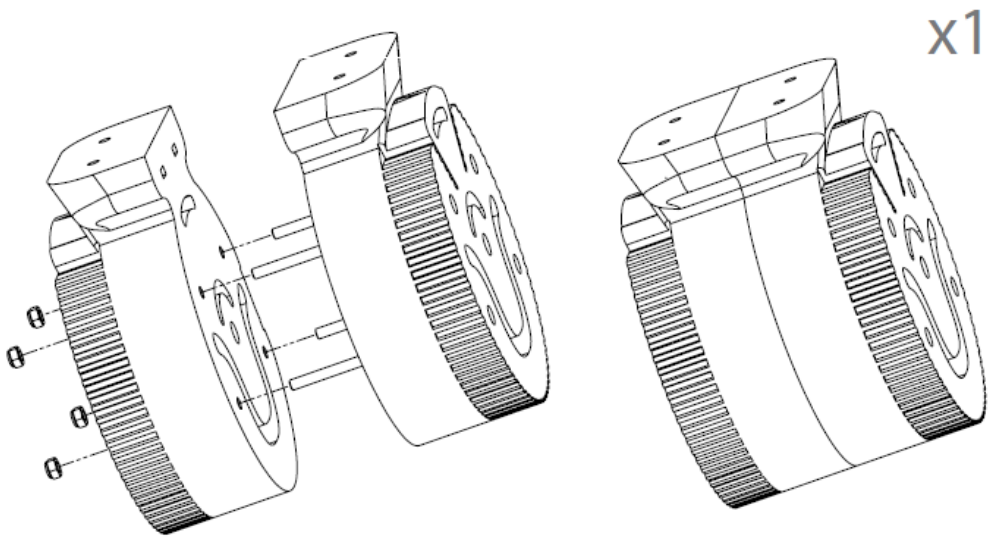
x1



BOM ID	Description	Qty
81	Base motor mount	1
42	Nema 17 long motor	1
12	Screw M3 x 8 mm	4
11	T5 Pulley 5 mm Bore	1

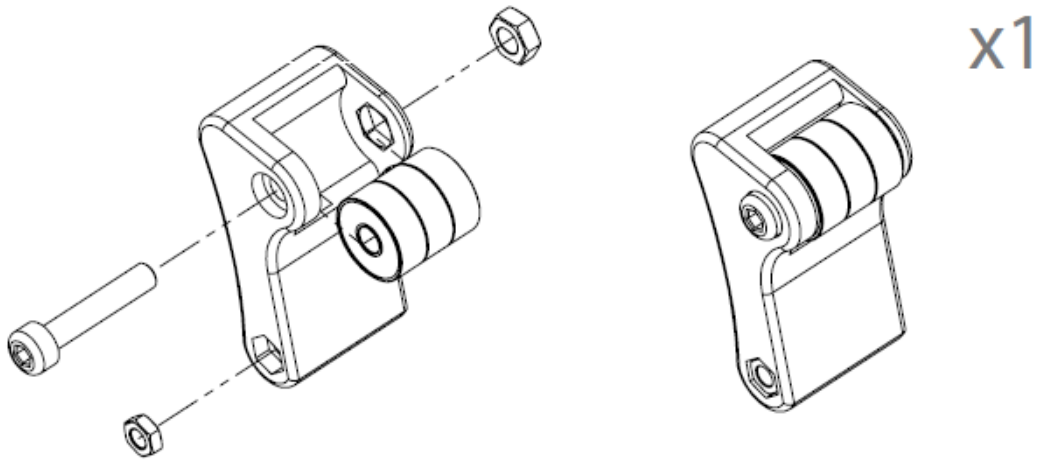
MODULE 2: WIRST

Step 1: Shoulder joint assembly



BOM ID	Description	Qty
82	Shoulder joint	2
24	Screw M4 x 40 mm	4
34	M4 locknut	4

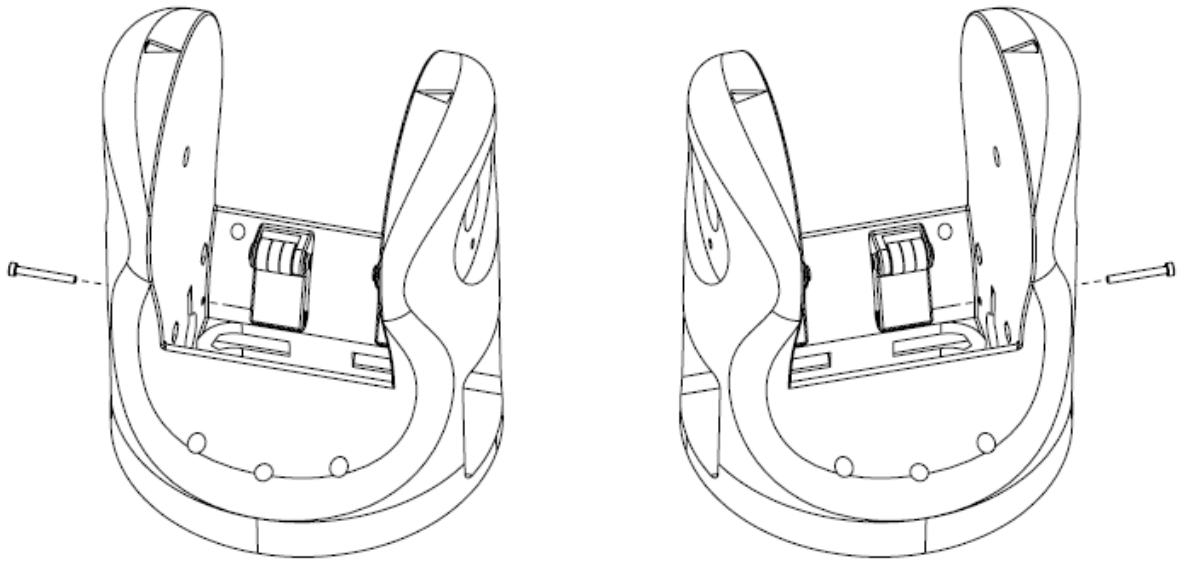
Step 2: Shoulder base tensioner assembly



BOM ID	Description	Qty
71	Shoulder base tensioner left	1
21	Screw M4 x 20 mm	4
32	M4 nut	1
33	M3 nut	1
3	Bearing 4mm x 13mm x 5mm	3

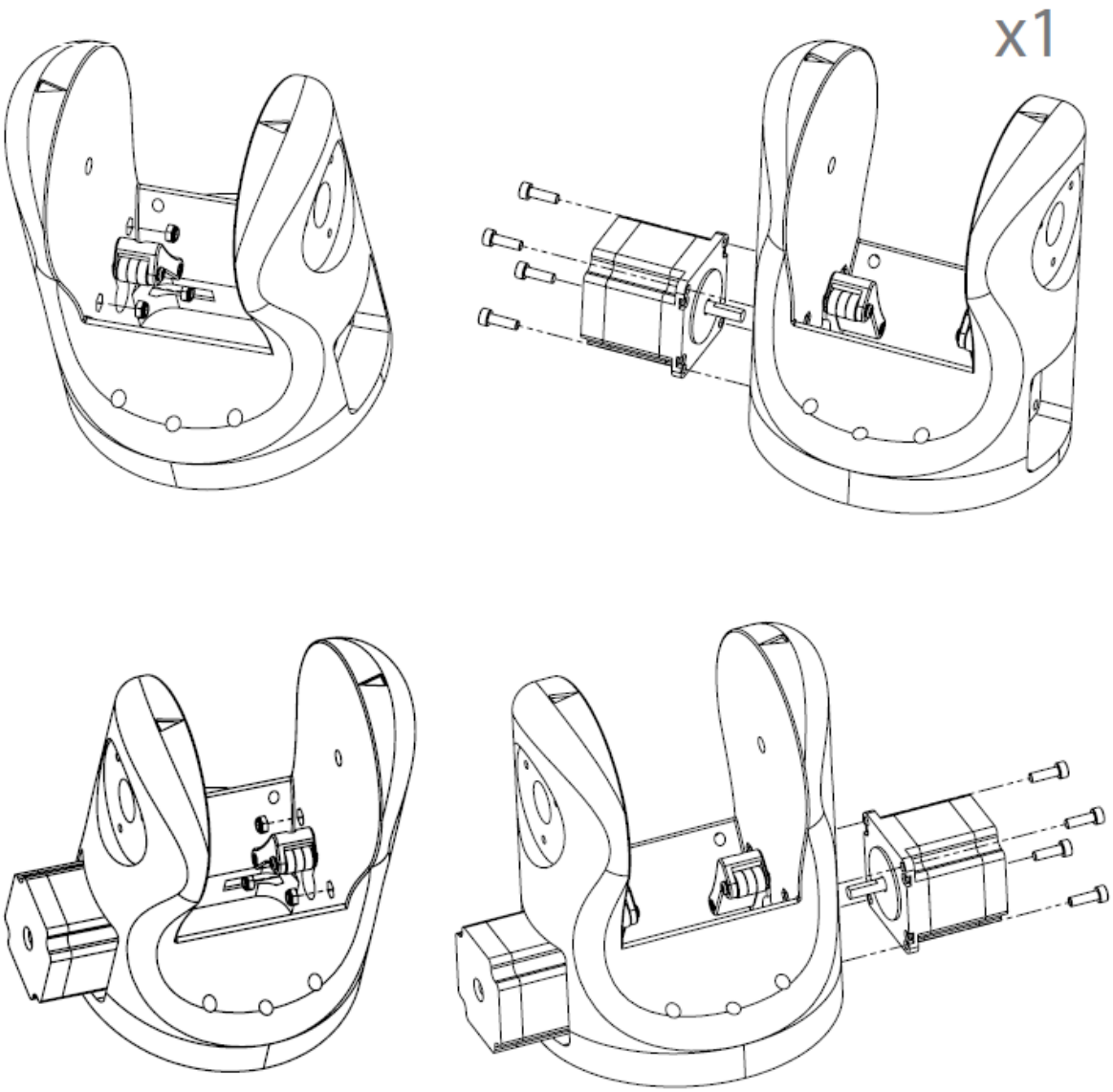
Repeat the operation with the right shoulder base tensioner.

Step 3: Shoulder base assembly



BOM ID	Description	Qty
/	Shoulder base assembly	2
17	Screw M3 x 25 mm	2
75	Shoulder base	1

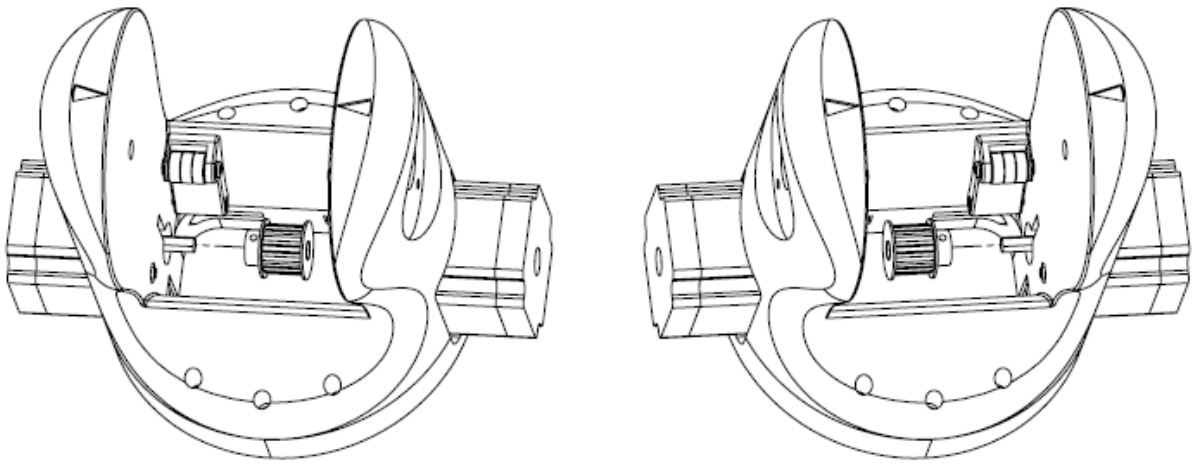
Step 4: Nema 23 Motor montage



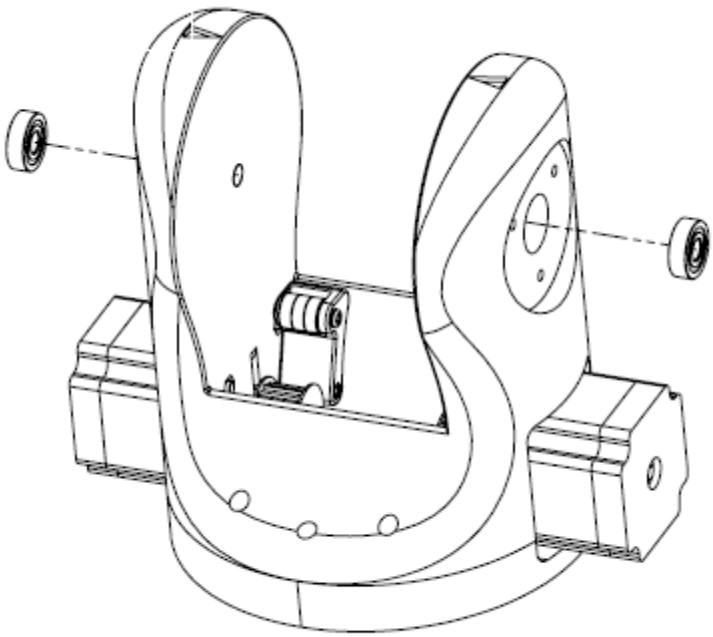
BOM ID	Description	Qty
39	Nema 23 Motor	2
27	Screw M5 x 14 mm	8
35	M5 locknut	8

Step 5: Pulley and bearings mounting

x1



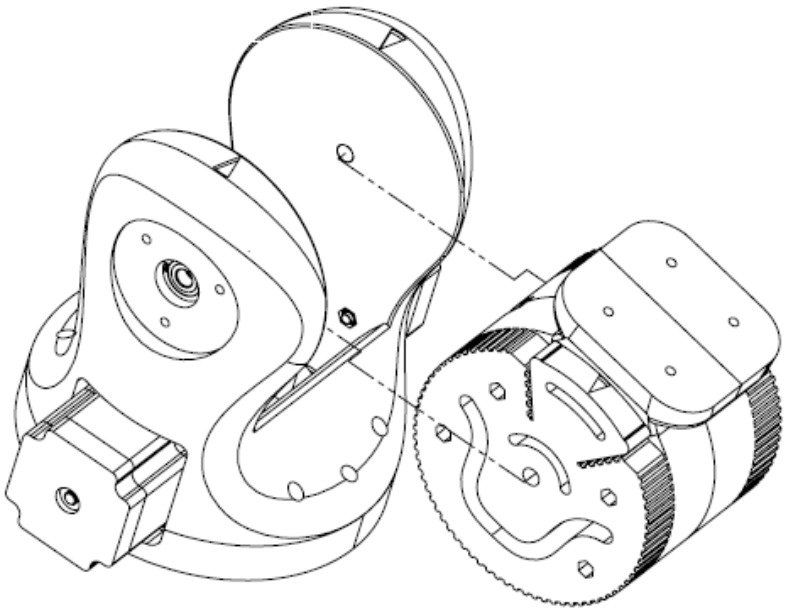
x1



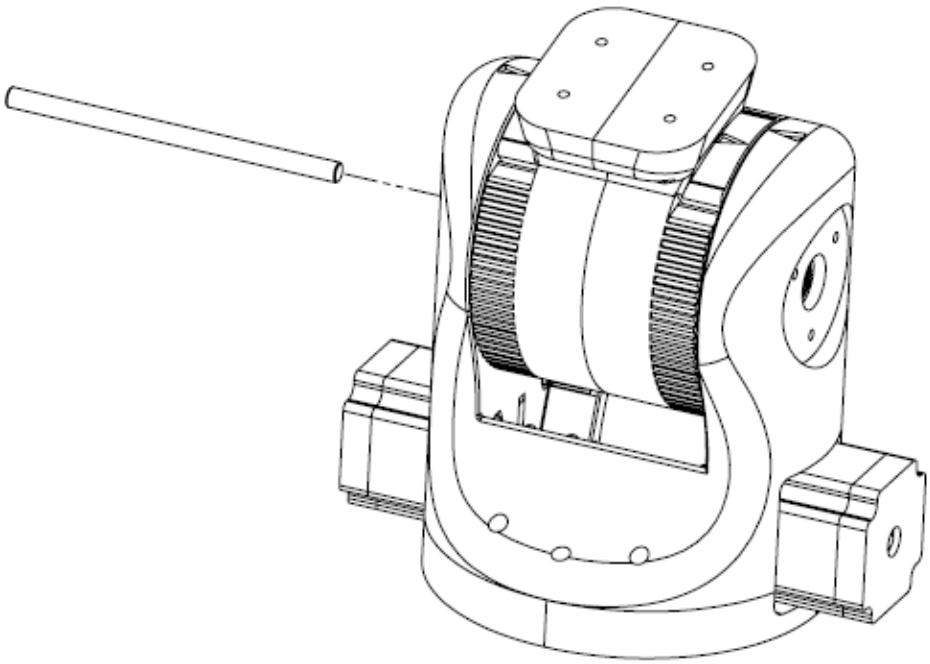
BOM ID	Description	Qty
10	T5 Pulley 8mm Bore	2
1	Bearing 8mm x 22mm x 7mm	2

Step 6: Module 2 assembly

x1

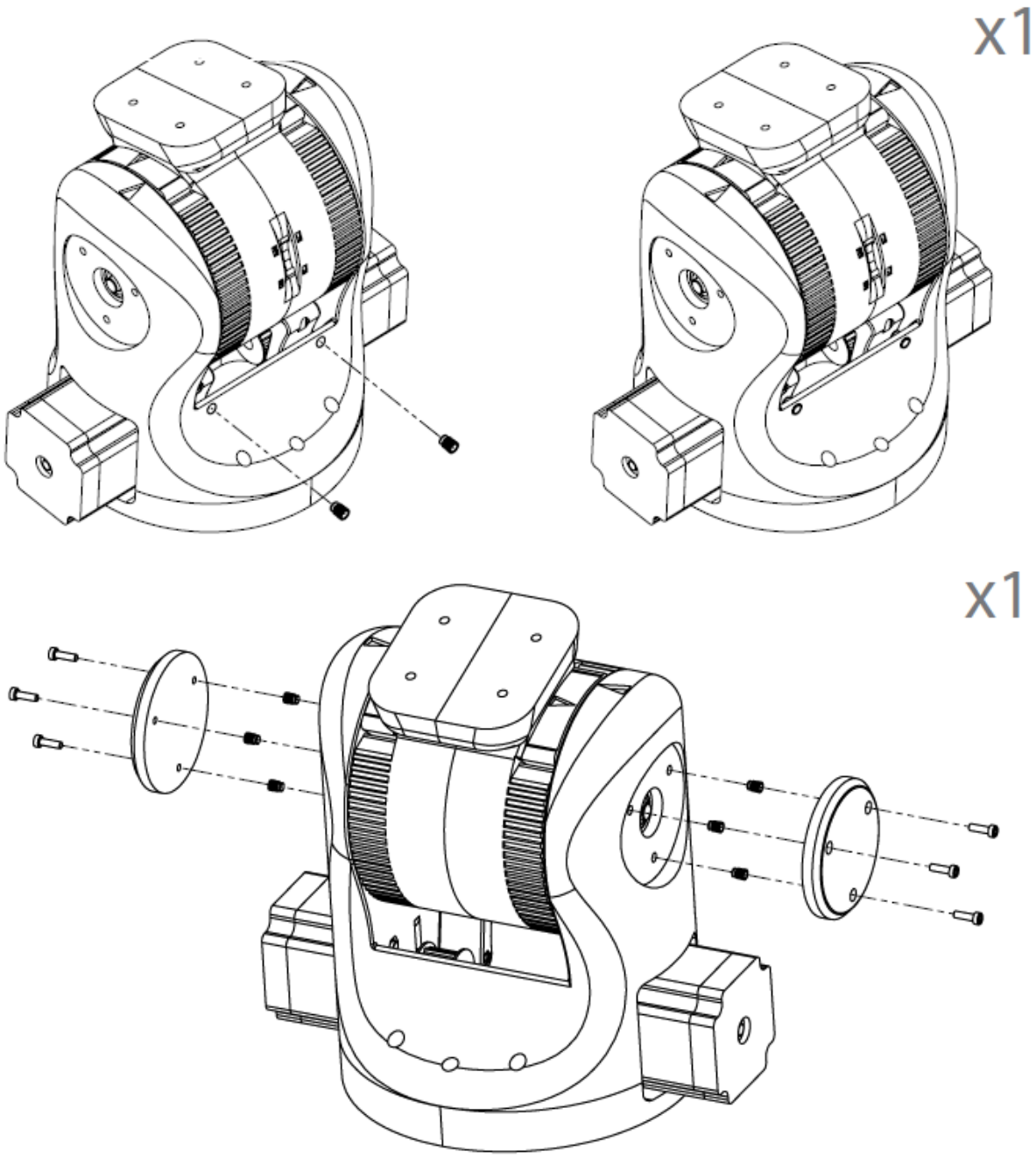


x1



BOM ID	Description	Qty
/	Shoulder joint assembly	1
6	8mm x 140mm Smooth Rod	1

Step 7: Inserts and cap mounting

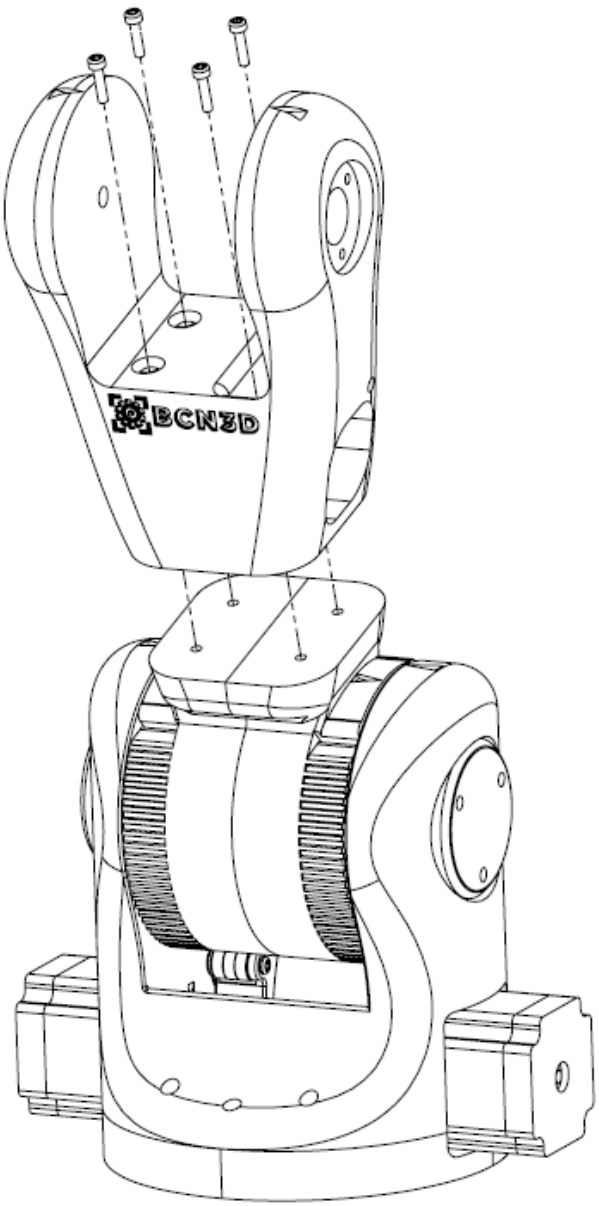


BOM ID	Description	Qty
38	M4 Insert	2
/	M3 Insert	6
62	Shoulder shaft cover	2
13	Screw M3 x 10 mm	6

MODULE 3: FIRST ARM

Step 1: Wrist base mounting

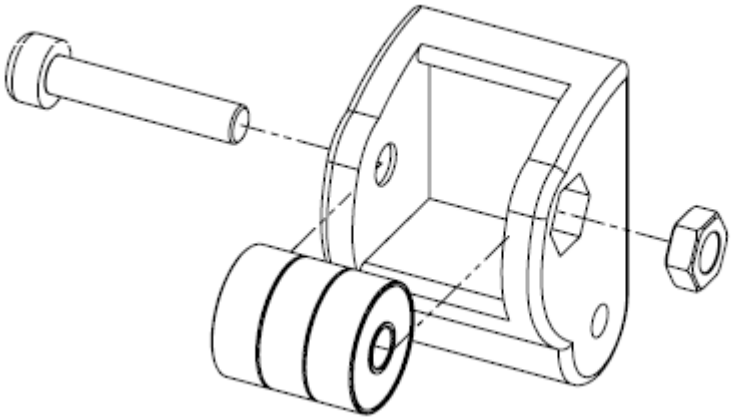
x1



BOM ID	Description	Qty
20	Screw M4 x 16 mm	4
/	Module 2	1
73	Wrist base	1

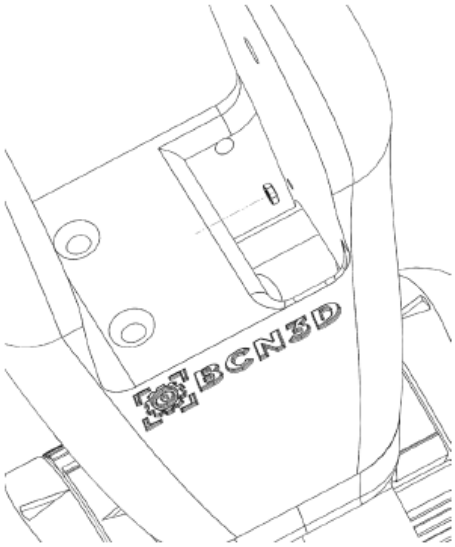
Step 2: Wrist belt tensioner assembly

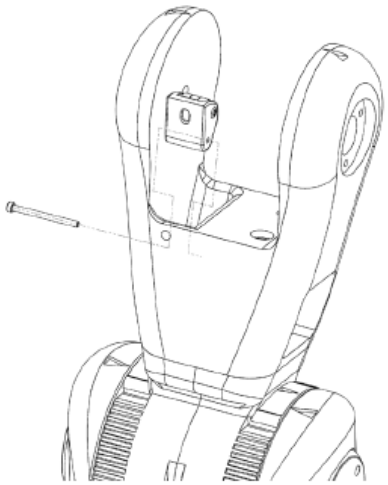
x1



BOM ID	Description	Qty
70	Wrist belt tensioner	1
3	Bearing 4mm x 13mm x 5mm	3
21	Screw M4 x 20 mm	1
32	M4 Nut	1

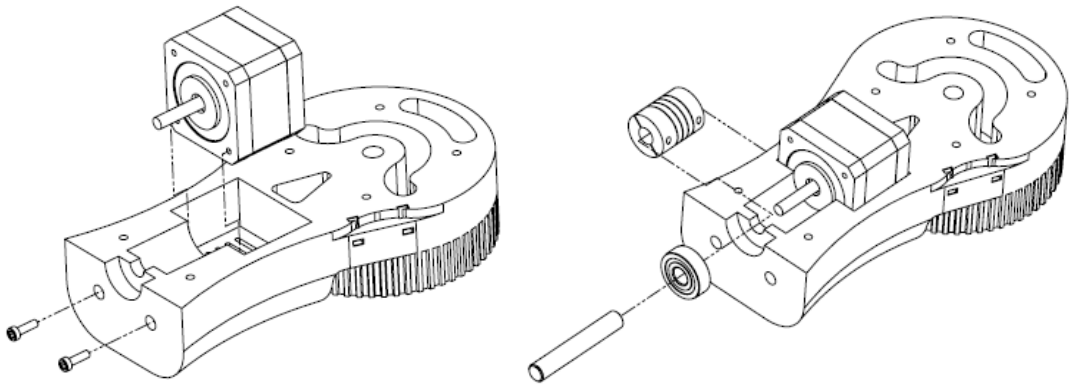
x1





BOM ID	Description	Qty
19	Screw M3 x 40 mm	1
/	Wrist base tensioner assembly	1
33	M3 Nut	1

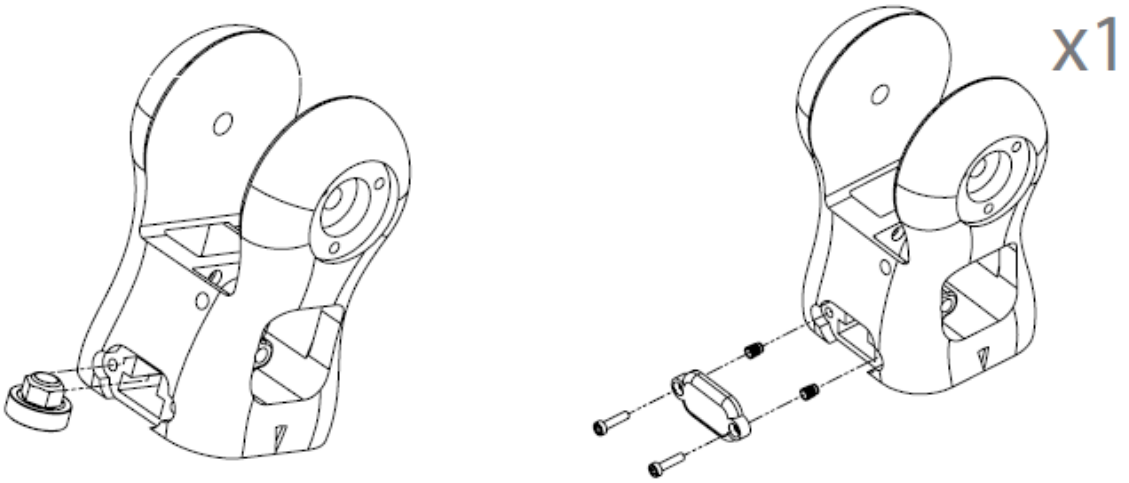
Step 3: Elbow assembly



BOM ID	Description	Qty
78	Elbow joint half 1	1
41	Nema 17 motor	1
13	Screw M3 x 10 mm	2
44	Beam coupling	1
5	8mm x 40mm Smooth Rod	1

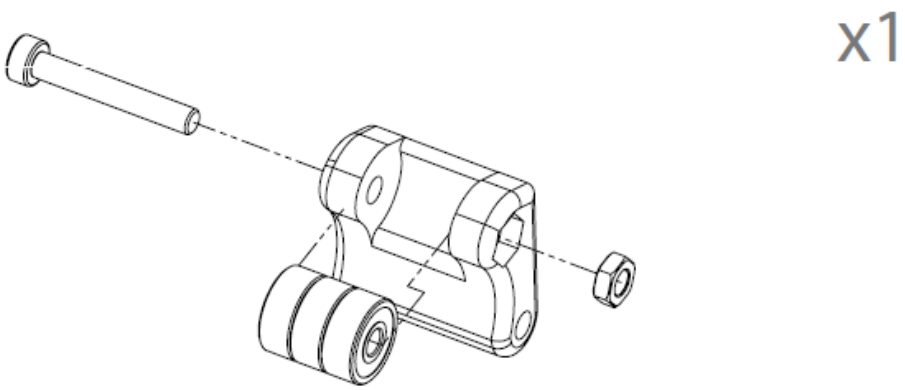
MODULE 4: CLAMP WRIST ASSEMBLY

Step 1: Locknut and bearing mounting



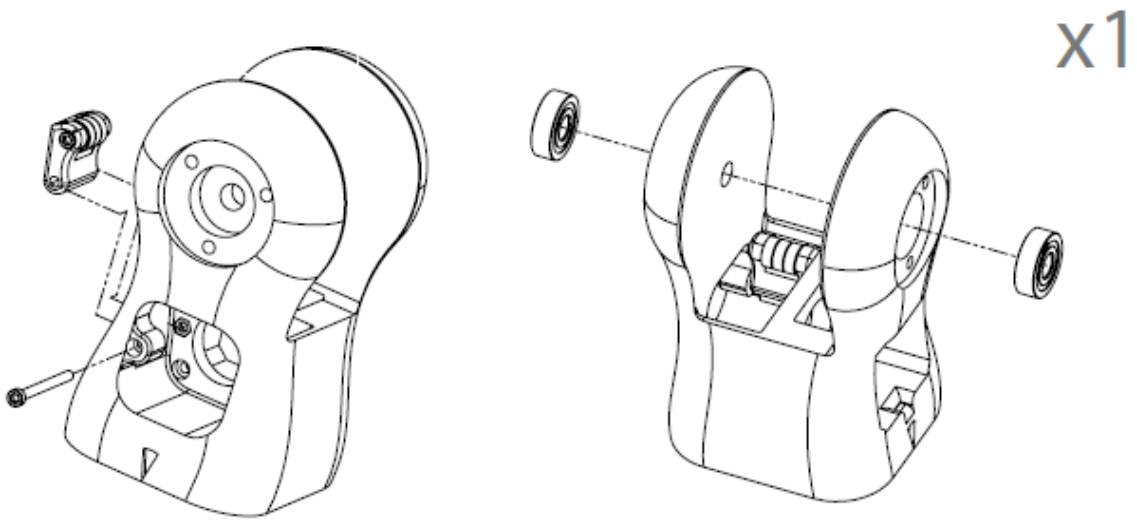
BOM ID	Description	Qty
73	Wrist base	1
1	Bearing 8mm x 22mm x 7mm	1
36	M8 locknut	1
/	Insert M3	2
60	Wrist back cover	1
14	Screw M3 x 12mm	2

Step 2: Elbow belt tensioner assembly

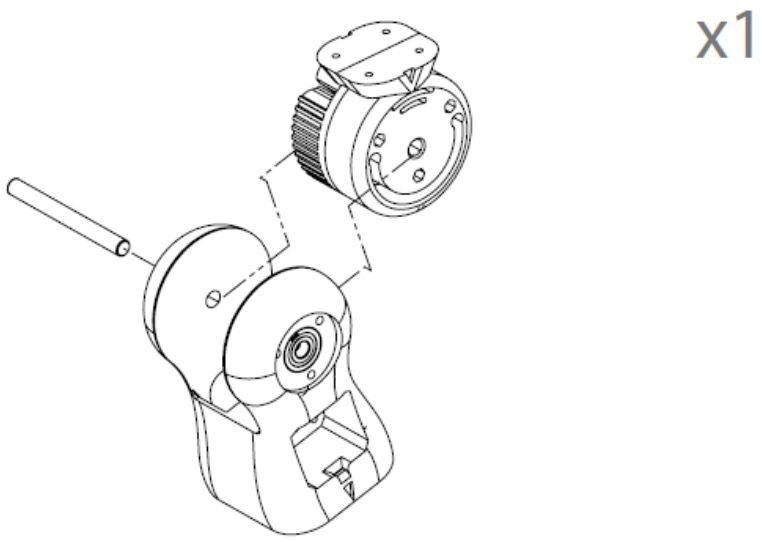


BOM ID	Description	Qty
69	Elbow belt tensioner	1
4	Bearing 3mm x 10mm x 4mm	3
33	M3 Nut	1
16	Screw M3 x 20 mm	1

Step 3: Wrist base assembly



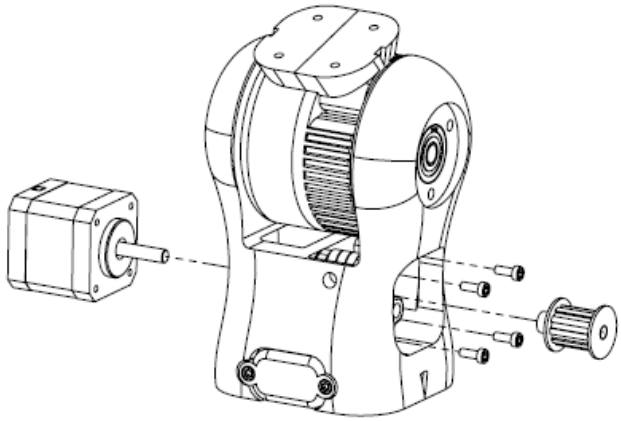
BOM ID	Description	Qty
/	Elbow belt tensioner	1
33	M3 Nut	1
18	Screw M3 x 35 mm	1
1	Bearing 8mm x 22mm x 7mm	2



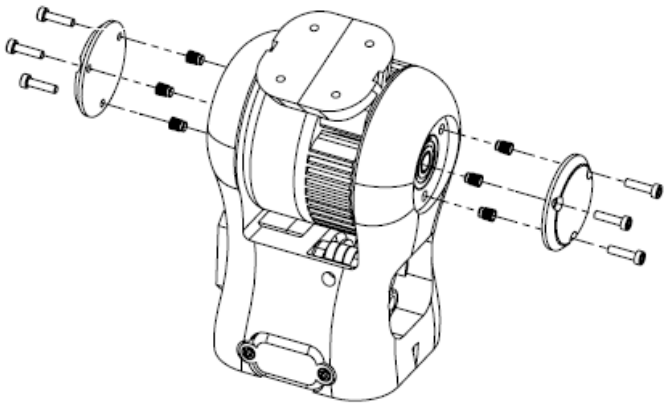
BOM ID	Description	Qty
76	Wrist half	2
/	M3 insert	4
22	Screw M4 x 25 mm	3
8	8mm x 80mm Smooth Rod	8

Step 4: Nema 14 mounting

x1



x1



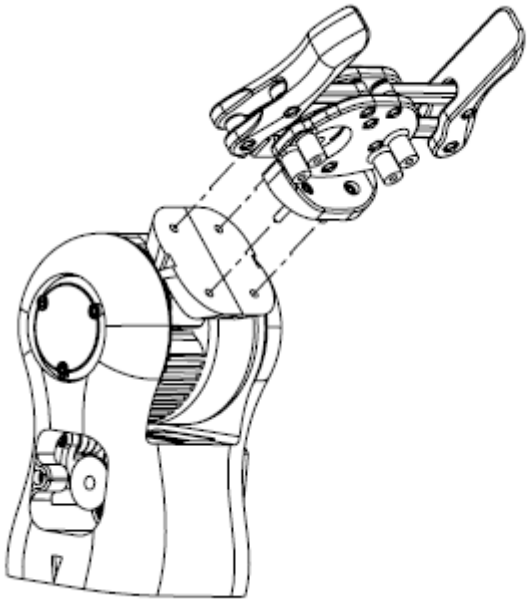
BOM ID	Description	Qty
43	Nema 14 Motor	1
10	T5 Pulley 8mm Bore	1
12	Screw M3 x 8 mm	4
/	M3 insert	6
12	Screw M3 x 12 mm	6
61	Wrist shaft cover	2

Step 5: Clamp assembly

To see a video of the assembly, please scan the following QR code:

BOM ID	Description	Qty
58	Gripper doubled plate	1
63	Servo Gear B	1
64	Servo Gear A	1
65	Pivot Arm B	4
66	Gripper left	2
67	Gripper right	2
68	Gripper bottom plate	2
74	Cylinder	4
18	Screw M3 x 35mm	5
13	Screw M3 x 10mm	1
15	Screw M3 x 16mm	12
33	M3 Nut	14

Step 6: Clamp mounting

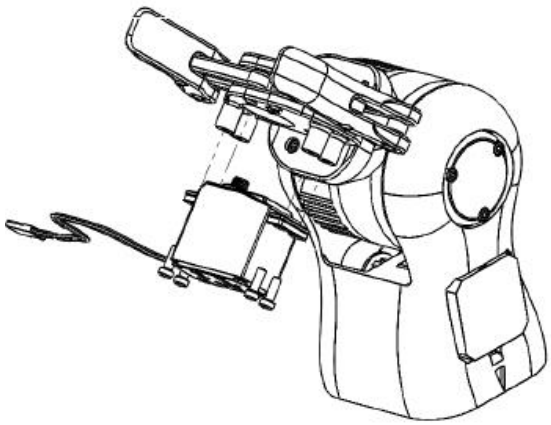


x1

BOM ID	Description	Qty
/	Wrist base assembly	1
/	Clamp v2	1

The version of the clamp illustrated here is the original one, please replace it by the new doubled version. The fixation system remains the same.

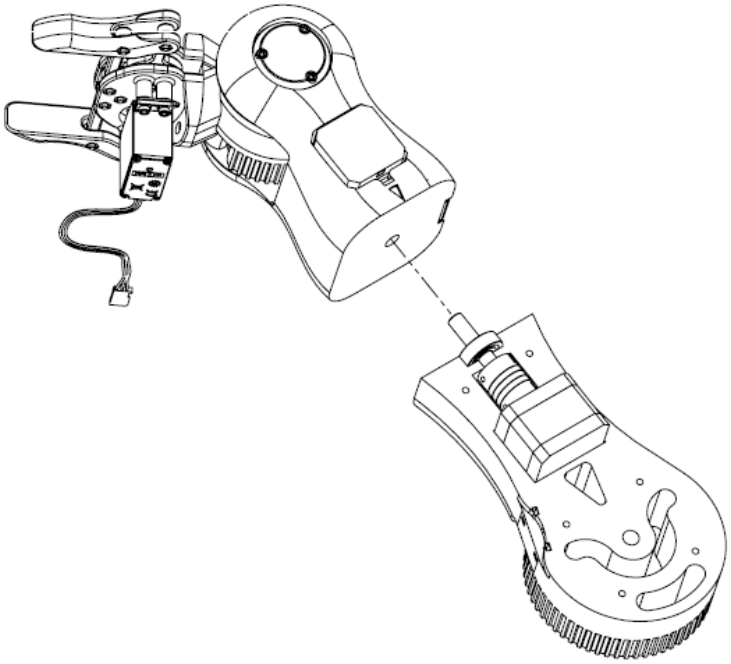
Step 7: Installing the 2 servos



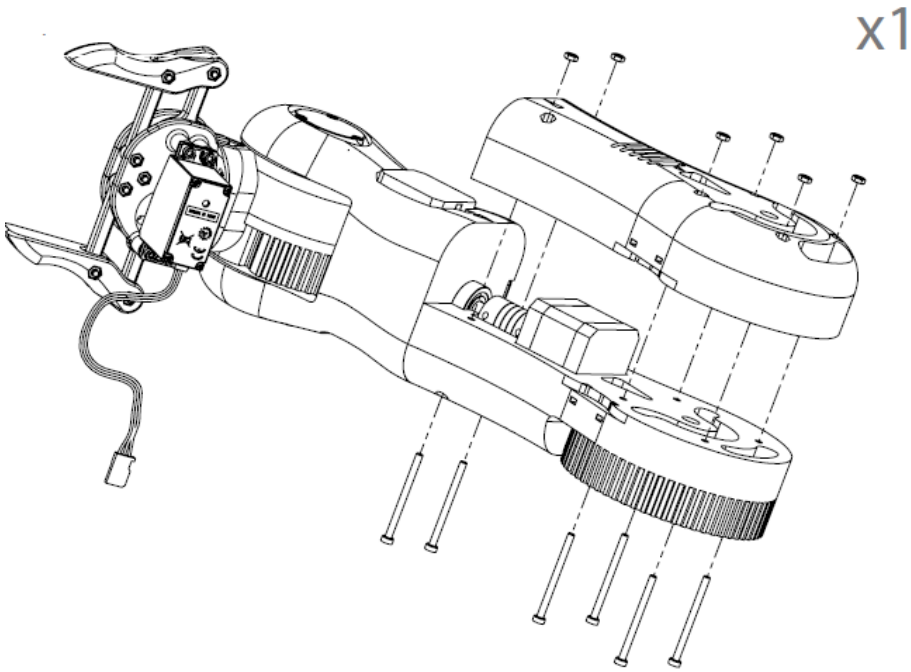
x1

BOM ID	Description	Qty
45	Servo motor	2
/	Wrist assembly	1
13	Screw M3 x 10mm	8

Step 8: Link the wrist and the elbow

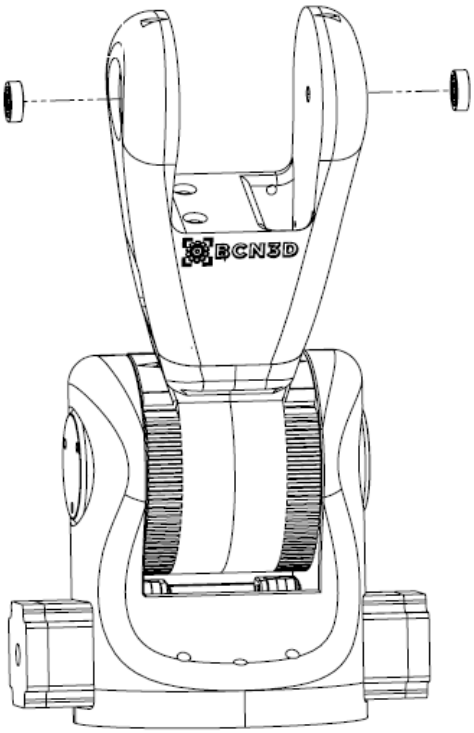


x1

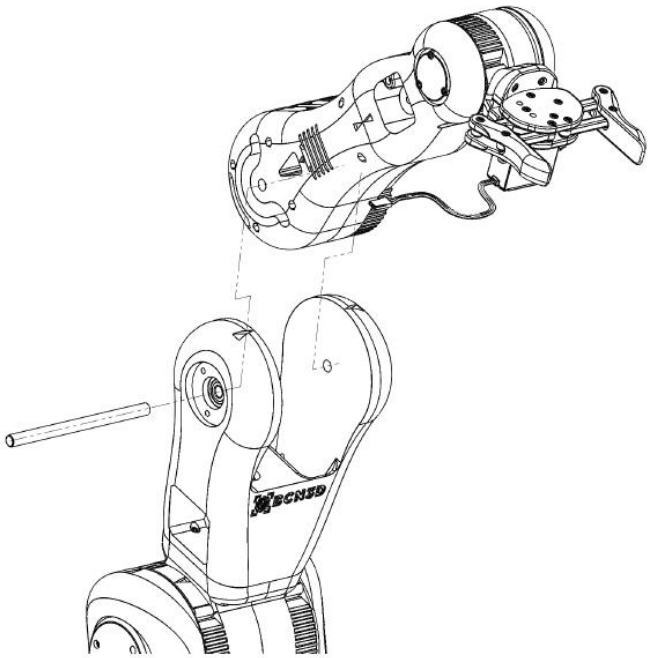


BOM ID	Description	Qty
/	Wrist assembly with clamp	1
/	Elbow assembly	1
19	Screw M3 x 40mm	6
33	M3 Nut	6
79	Elbow joint half 2	1

Step 9: Installing the bearings and mounting the elbow

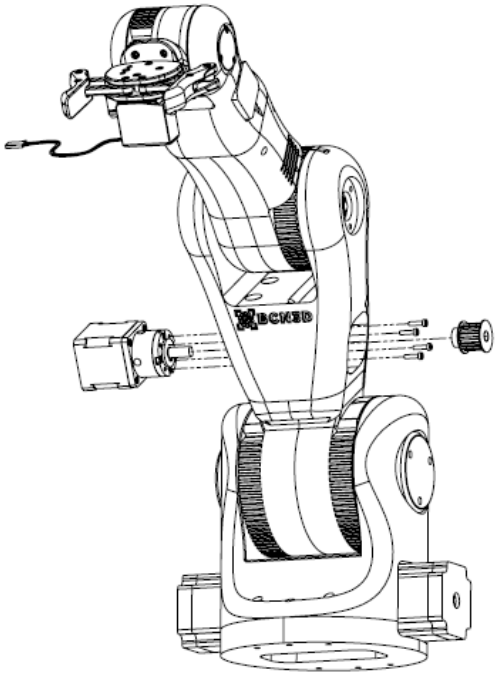


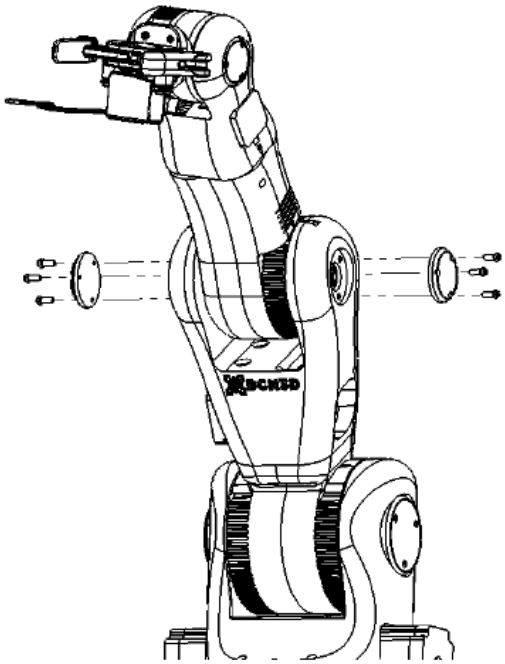
BOM ID	Description	Qty
1	Bearing 8mm x 22mm x 7mm	1



BOM ID	Description	Qty
7	8mm x 115mm Smooth Rod	1

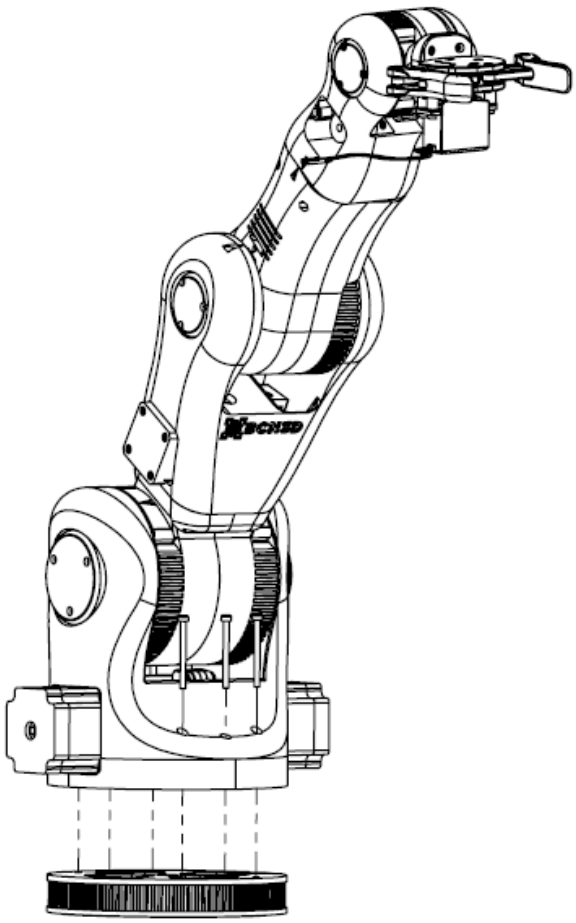
Step 10: Mounting the geared motor Nema 17





BOM ID	Description	Qty
40	Nema 17 5:1 Geared Motor	1
10	T5 Pulley 8mm Bore	1
33	M3 Nut	4
13	Screw M3 x 10mm	10
62	Shoulder shaft cover	2

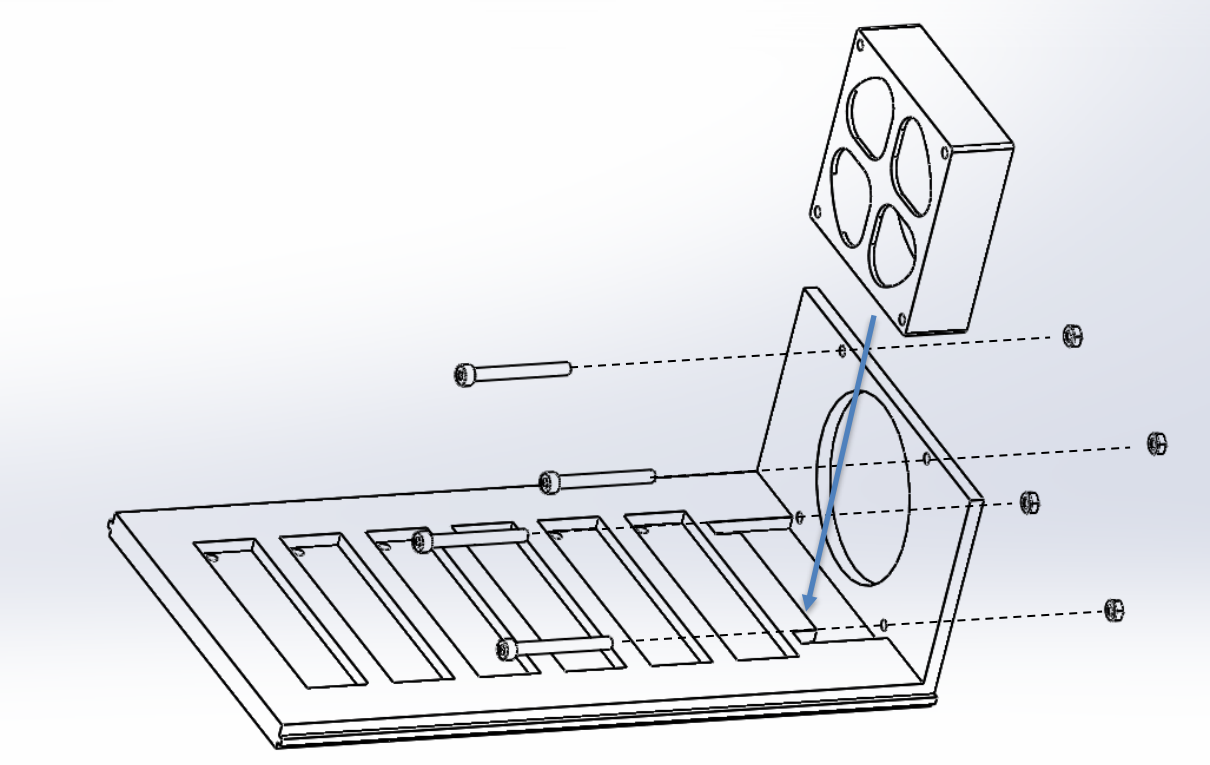
Step 11: Assembly of the arm and the base



BOM ID	Description	Qty
84	Rotary Plate	1
/	Whole robot	1
25	Screw M4 x 45 mm	6

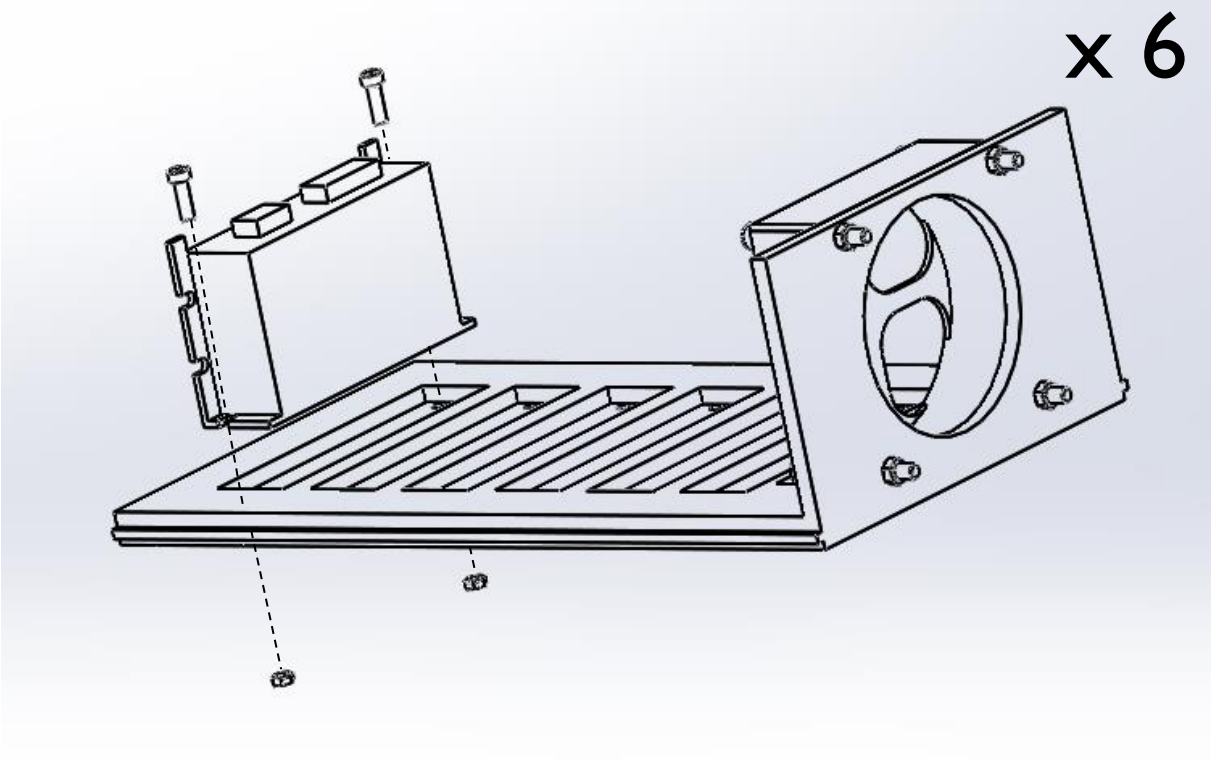
DRIVERS BOX

Step 1: Place and screw the fan on the drawer



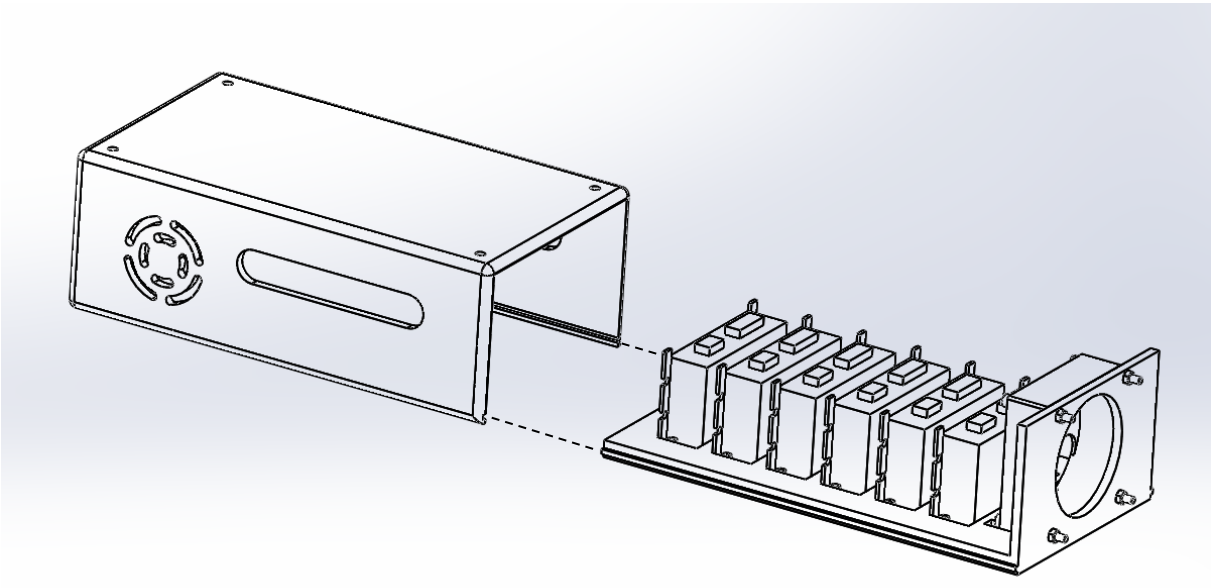
BOM ID	Description	Qty
53	Fan	1
24	Screw M4 x 40 mm	4
32	M4 Nut	4
85	Driver box	1
86	Driver box drawer	1

Step 2: Place and screw the drivers on the drawer



BOM ID	Description	Qty
48	Makeblock Drivers motor 130599	6
14	Screw M3 x 12mm	12
33	M3 Nut	12

You can now insert the drawer into the box.



Take off the drawer, screw the box to the table and wire everything (See the wiring part).

WIRING

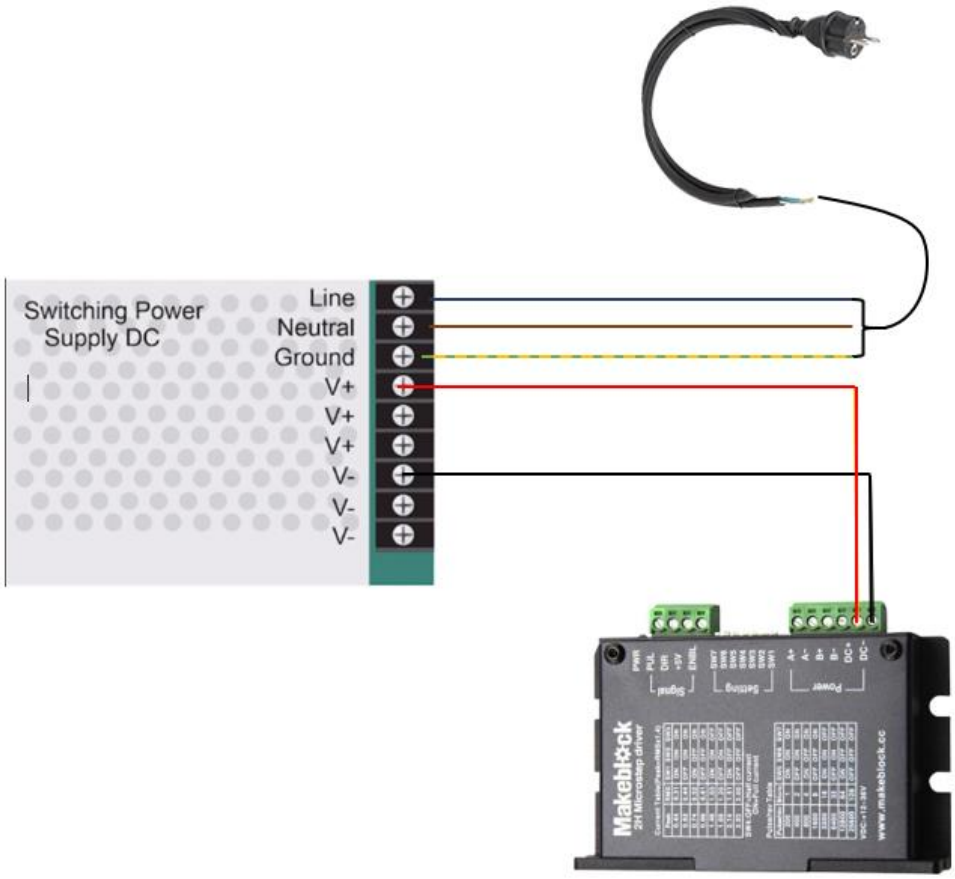
Driver to power supply:

Retire the plastic protection and connect the 3 wires from the general electrical outlet to the power supply using a screwdriver.

Blue wire → "Line"
Brown wire → "Neutral"
Green and yellow → "Ground"
These three wires enable the power supply to be powered on with the electrical network.

Be careful! Always manipulate the wires without any voltage before plugging in to the electrical network.

Then connect the + and - ports to the DC+ and DC- ports of the driver.



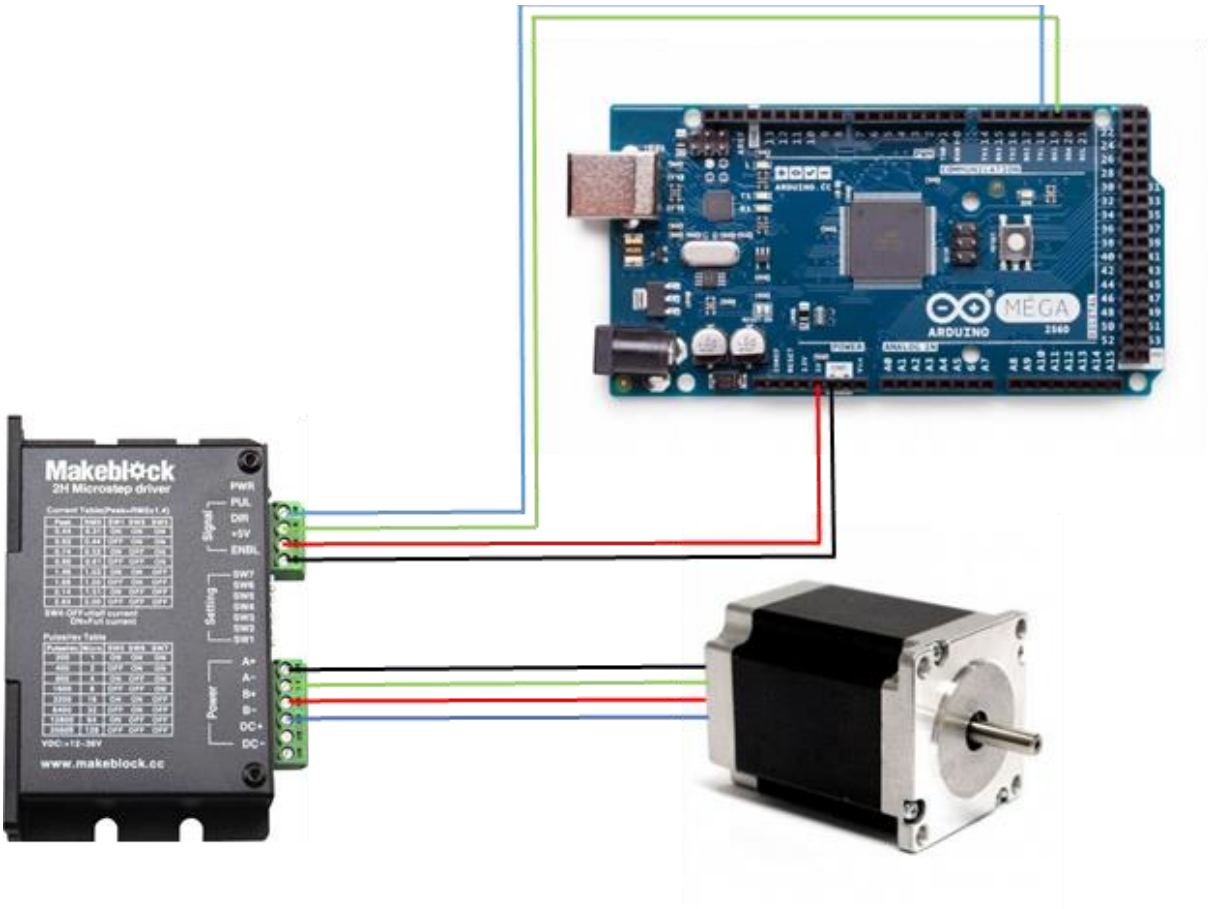
Driver to stepper motor:

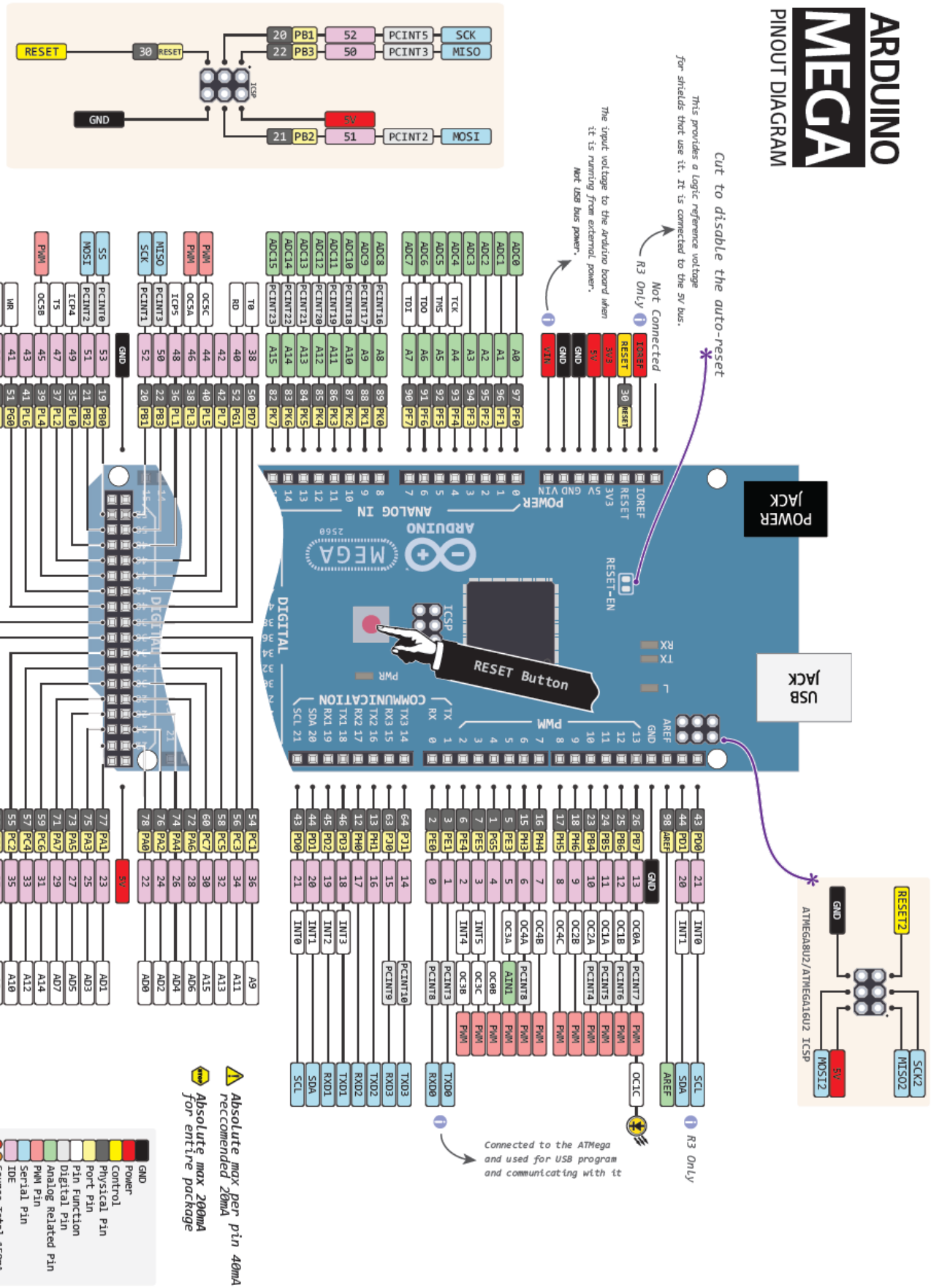
Connect the motor's cables to the ports A+, A-, B+, B- of the driver. Report to the color code of the diagram below to know how to wire properly each cable to each port.

Then connect the PUL and DIR port to the PWM ports of the Arduino (cf. Arduino board details on the next page if you want a detailed view of the card).

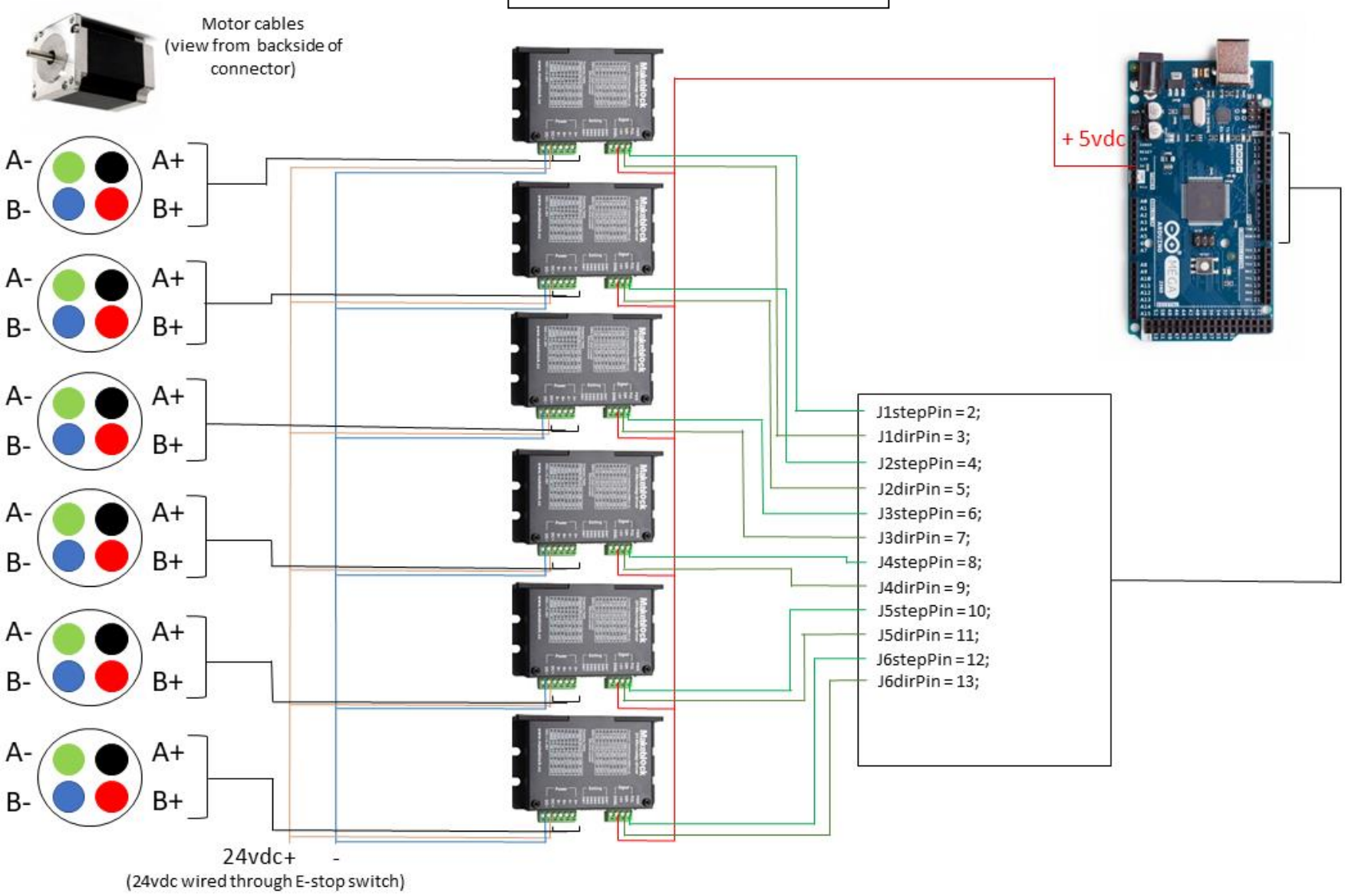
> Please refer to the general diagram to respect the pin wiring that comes with the Arduino code of the AR2 software.

Synchronize the wiring of the +5V of every driver and connect it to the +5V of the Arduino card. Then link all the ENBL ports together and connect them to the GND port of the Arduino.




ARDUINO
MEGA
PINOUT DIAGRAM
Cut to disable the auto-reset
This provides a Logic reference voltage for shields that use it. It is connected to the 5V bus.
The input voltage to the Arduino board when it is running from external power. Not USB bus power.
R3 Only
Not Connected
POWER JACK
USB JACK
RESET Button
ICSP
RESET-EN
ANALOG IN
DIGITAL
COMMUNICATION
PWM
Connected to the ATMega and used for USB program and communicating with it
R3 Only
Absolute max per pin 40mA reccomended 20mA
Absolute max 200mA for entire package
ATMEGA8U2/ATMEGA16U2 ICSP
GND
Power
Control
Physical Pin
Port Pin
Pin Function
Digital Pin
Analog Related Pin
PWM Pin
Serial Pin
IDE
Source Total 150mA

Note: you also can link ENBL ports to the GND port of the Arduino

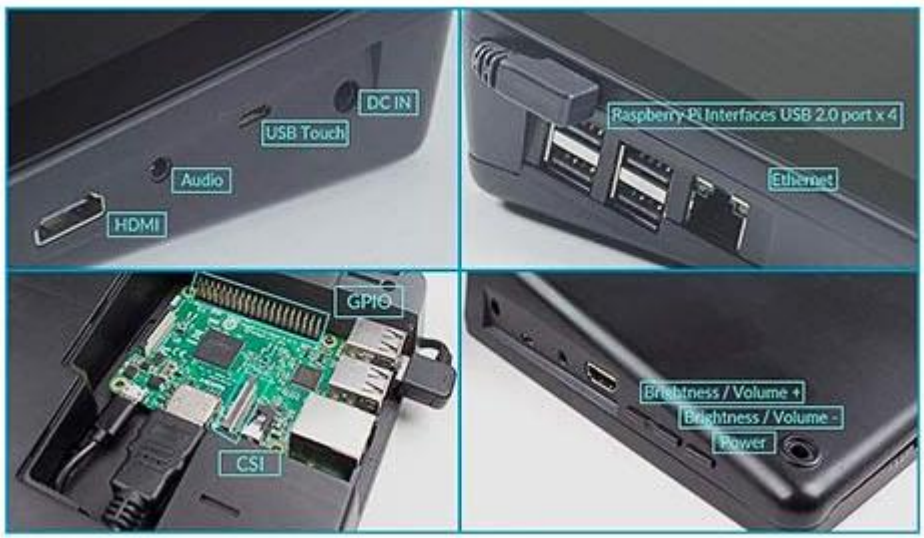


USE OF THE RASPAD TOUCH SCREEN

Features:

- 100% compatible with the Raspberry Pi 3B+
- A mobile workstation: lightweight frame, built-in battery, 10” touchscreen, and Audio In One
- Graphical User Interface Software available

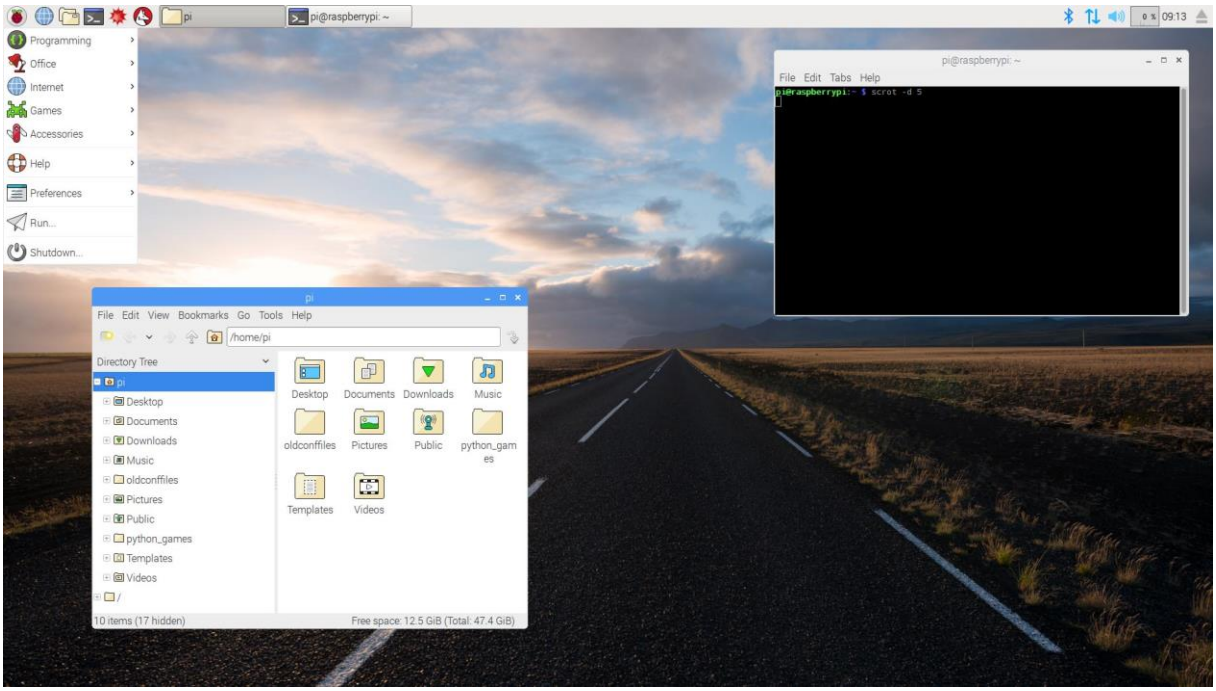
Ports and buttons of the Raspad touchscreen:



How to install the Raspberry Pi:

- Wire and nest in the reserved space
- We use the OS Raspbian on the Raspberry (we got it from the group from the previous year)

Homepage:

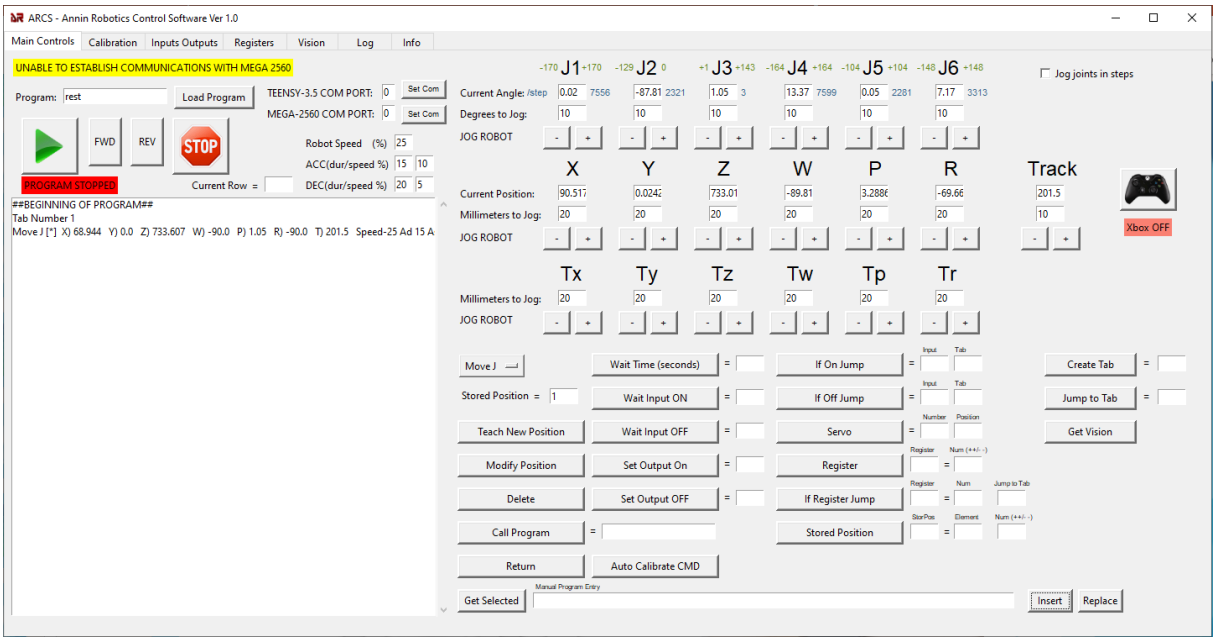


To get comfortable with the Raspbian OS, we strongly recommend you to follow some online tutorials. There are plenty of them, you can find it very easily.

PROGRAM POSSIBILITIES

To program the robot, we strongly advise to use the AR2 software developed by Chris Annin from Annin Robotics. This program is not initially made for the Moveo robot but is compatible with it since it is based on the usage of an Arduino Mega 2650 and is adapted to 6 axis robots.

This is how the interface looks like:



First thing to do is to download the Arduino code of the movement available on the site. Once you got the program file, connect your Arduino Mega in USB to your computer (PC or Raspberry Pi) and upload the program on the card.
If you open the program, you will see that each motor is assigned a name: J1 to J6.
Please note that in our case, we have an additional servomotor that you will have to synchronize with the first one directly on the program.

Once the Arduino part is ready, go on the AR2 software and configure your COM ports to indicate the program on which USB port your Arduino board is connected. It must be the same as the one you chose in the Arduino panel.

Then follow the instructions given in the following video tutorials to calibrate and program the whole robot.

Links:

Download the Arduino code of the movement:
https://drive.google.com/file/d/1FmR09i1jQjmoevpChq8_C6hxI3Wj1p4Z/view?usp=sharing

Download the Raspberry Pi version of the software:
https://github.com/Chris-Annin/AR2/tree/master/RaspberryPi
A guide to install properly the software on the Raspberry Pi is available when you scroll down the page. Follow the instructions to download and install AR2 on your RPi.

Download the .exe program (for PC) use this link:
https://drive.google.com/file/d/1YJ4FmsQDdoEVLniaclle1VKWnJ4e4gte/view?usp=sharing

VIDEO TUTORIALS
https://www.anninrobotics.com/tutorials