wefaa robotics

smorphi 2

transforming learning with transformer robots

assembly & info

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SMORPHI ASSEMBLY

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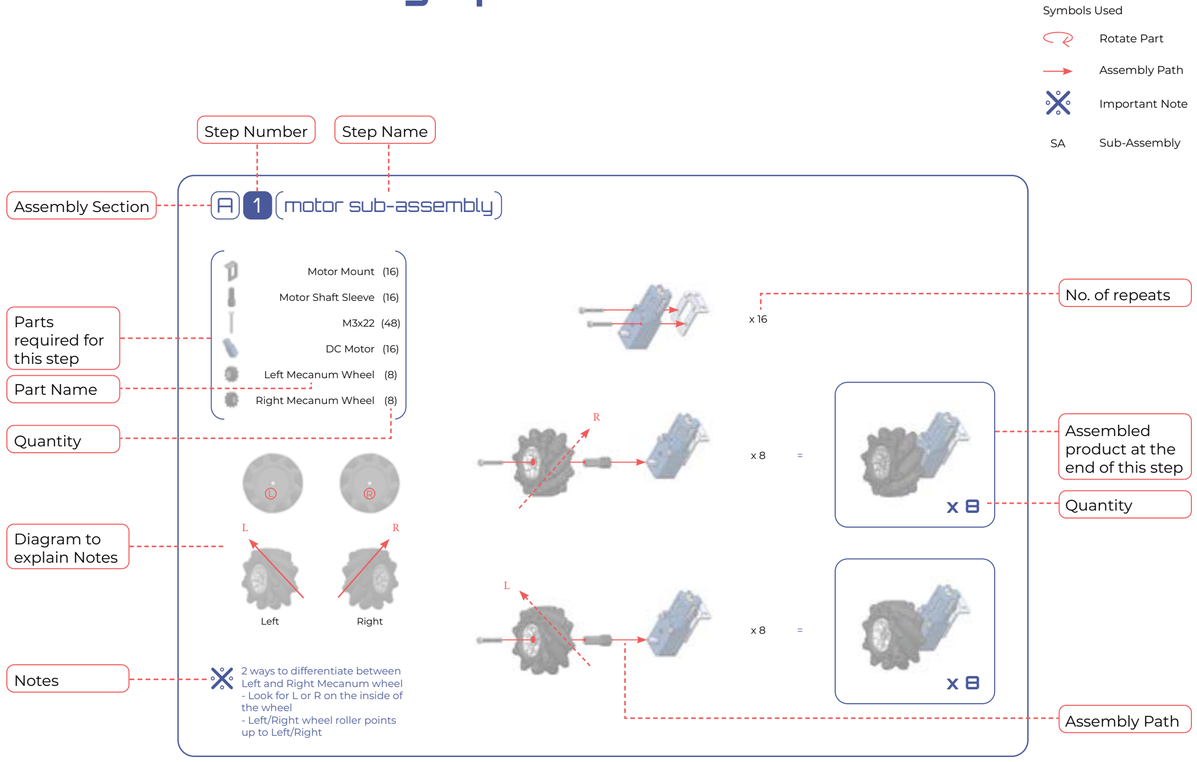
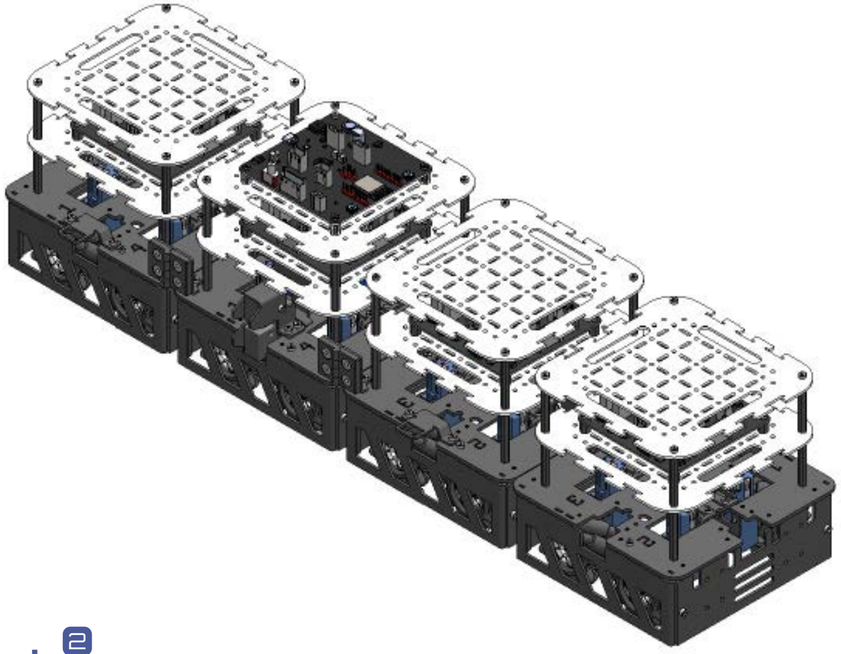
part list

All colors of parts are represented accurately here.
In the assembly steps, colors of some parts will be changed for diagram clarity.

- 8 x Acrylic Base Plate
- 4 x Aluminium Base Plate
- 8 x Base Skirt Panel A
- 8 x Base Skirt Panel B
- 8 x Mecanum Wheel (Right)
- 8 x Mecanum Wheel (Left)
- 16 x Mecanum Motor
- 16 x Motor Shaft Sleeve
- 16 x Motor Mount
- 6 x Solenoid
- 6 x Solenoid Latch Mount
- 6 x Solenoid Latch Guide
- 6 x Solenoid Catch
- 6 x Hinge Mount
- 3 x Hinge Mechanism
- 1 x Battery
- 2 x Battery bracket
- 1 x Masterboard (ESP32)
- 4 x Slaveboard
- 2 x Sound Sensor
- 1 x Temperature Sensor
- 4 x IR Sensor
- 1 x Pixy2 Camera
- 1 x Pixy2 Mount
- 10 x Sensor Lock
- 32 x Hex M-F M3 Nylon 45mm
- 28 x Hex F-F M3 Nylon 10mm
- 200 x Cap Screw M3x5
- 50 x Cap Screw M3x25
- 15 x Countersunk Screw M4x8
- 2 x Wing Screw M3x5
- 1 x USB-C Cable
- 8 x 4-pin Connector
- 4 x 8-pin Connector
- 1 x Battery Charger
- 1 x Ceramic Screwdriver CD-25
- 1 x HEX Key 1.5mm
- 1 x Ribbon cable
  (included in pixycam package)

basic assembly tips



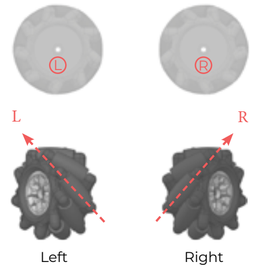


smorphi 2

assembly start

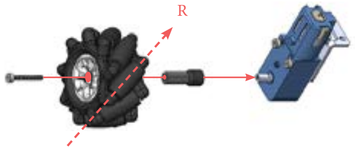
A 1 motor sub-assembly

Motor Mount	(16)
Motor Shaft Sleeve	(16)
M3x22	(48)
DC Motor	(16)
Left Mecanum Wheel	(8)
Right Mecanum Wheel	(8)



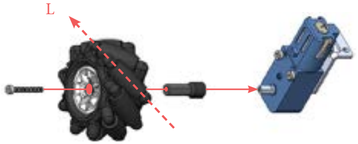
2 ways to differentiate between Left and Right Mecanum wheel
- Look for L or R on the inside of the wheel
- Left/Right wheel roller points up to Left/Right

x 16



x 8 =

x 8

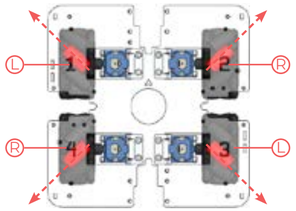


x 8 =

x 8

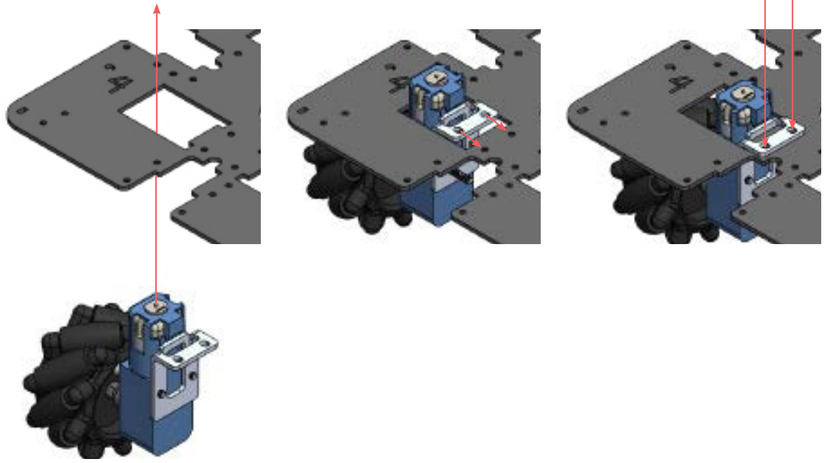
A2 base module sub-assembly

	Al Base Plate	(4)
	Hex M-F M3 45mm	(16)
	M3x5	(32)
	Left Wheel SA from A.1	(8)
	Right Wheel SA from A.1	(8)

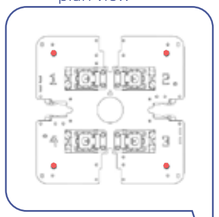


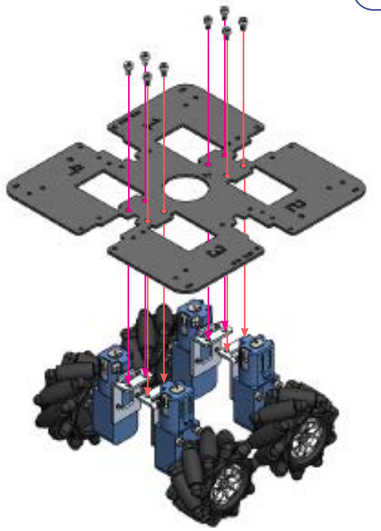
Make sure that the numbers are facing the right way up as shown in the plan view above.

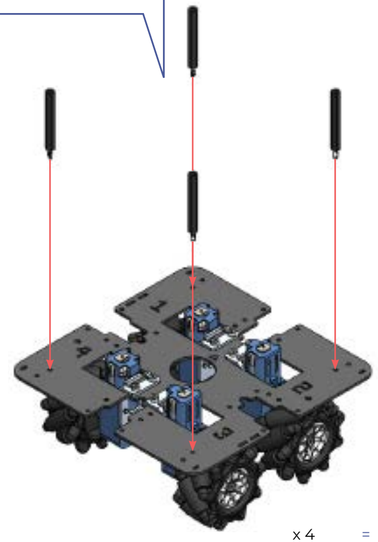
Before attaching each wheel, check that the wheel is of the correct orientation for each numbered slot.



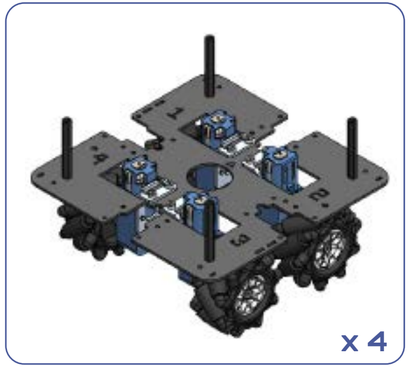
plan view







x 4 =

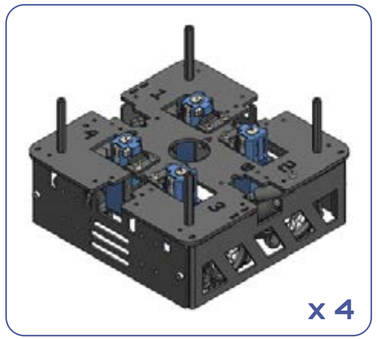


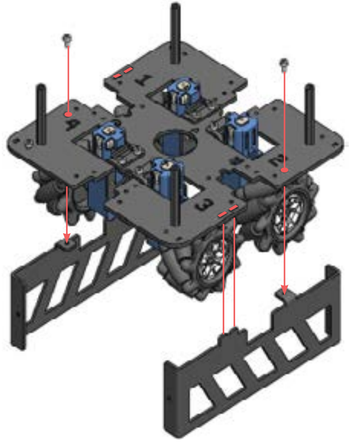
Base Skirt Panel A (8)

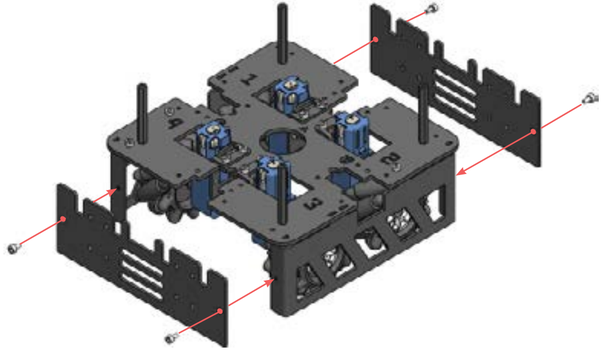
Base Skirt Panel B (8)

M3 x 5 (24)

x 4 =







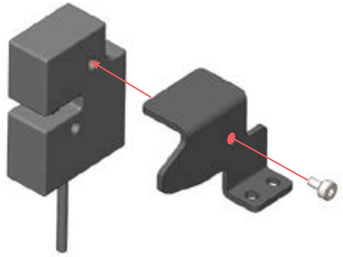
A3 solenoid latch sub-assembly

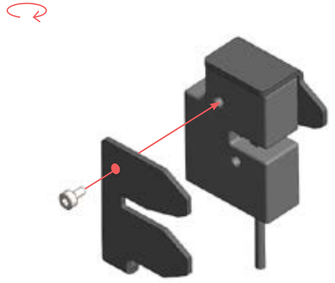
Solenoid latch (6)

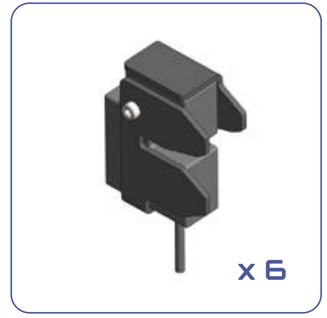
Solenoid latch mount (6)

Solenoid latch guide (6)

M3 x 5 (12)







A4 module 1 mechanical sub-assembly

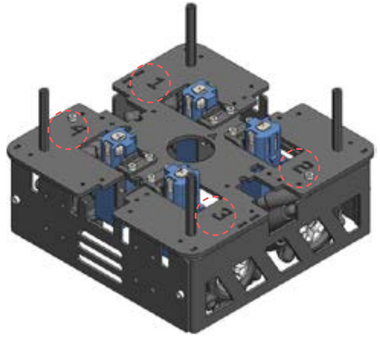

Hinge mount (1)

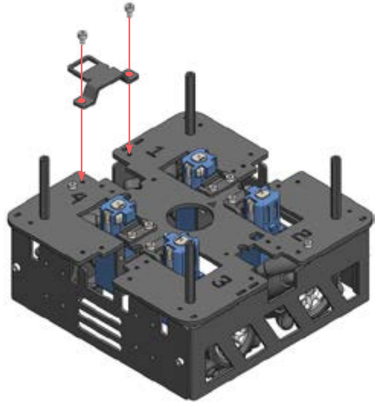

Solenoid catch (1)

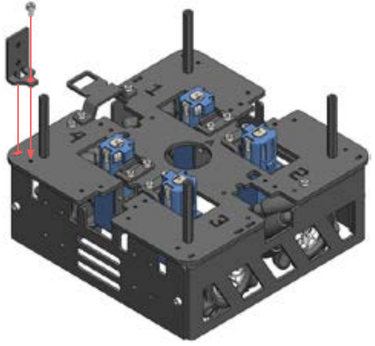

Solenoid latch SA (2)
from A.3


Base Module SA (1)
from A.2

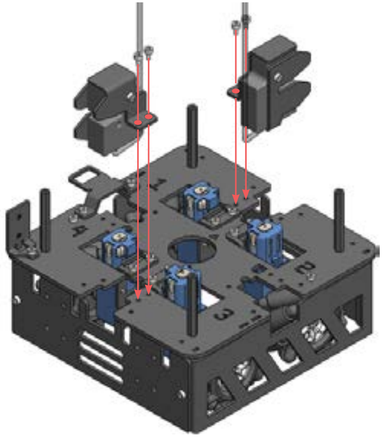

M3 x 5 (7)

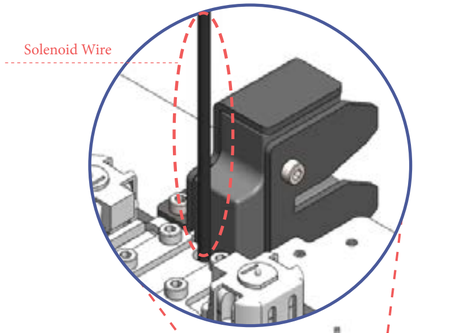


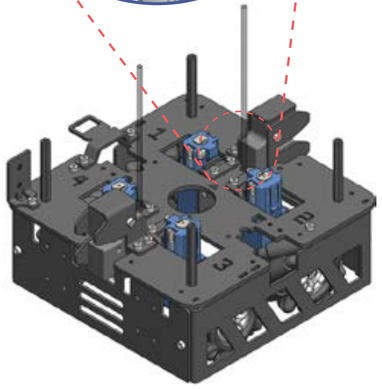


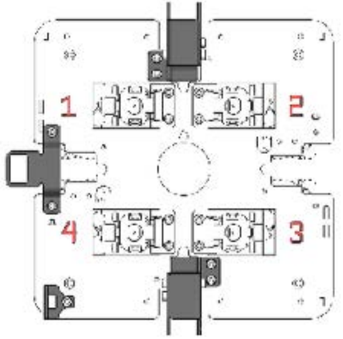


Pay attention to the numbers and their positions in relation to the parts being attached.





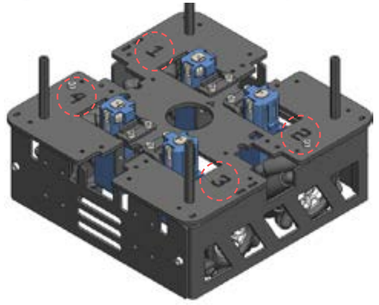


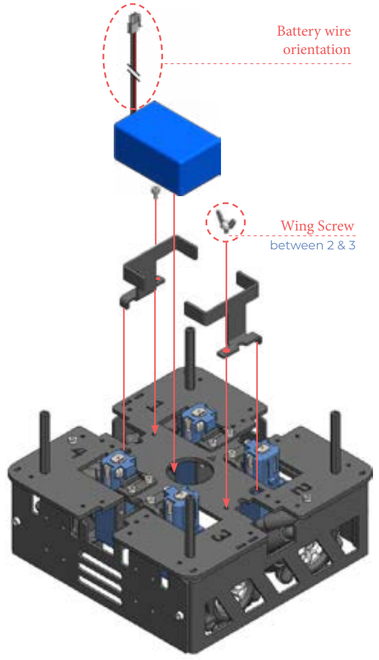


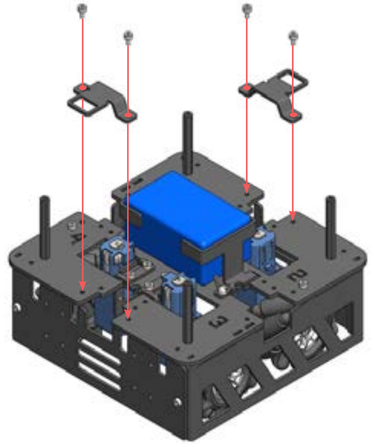
Check that the parts have been attached in the right location, in relation to the numbers.

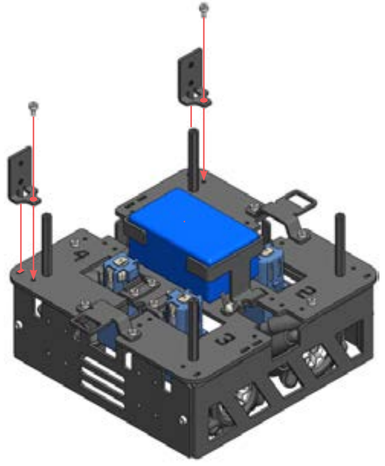
A.5 module 2 mechanical sub-assembly

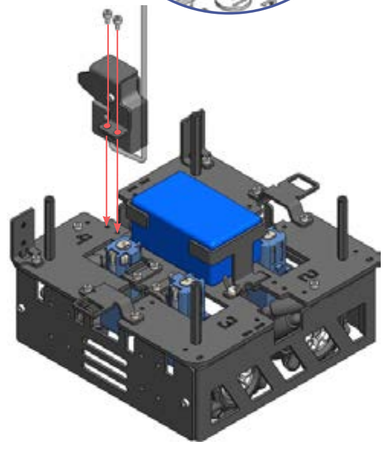
Hinge mount	(2)
Solenoid catch	(2)
Solenoid latch SA from A.3	(1)
Battery bracket	(2)
Li-ion Battery	(1)
Base Module SA from A.2	(1)
M3 x 5	(9)
Wing Screw M3 x 5	(1)

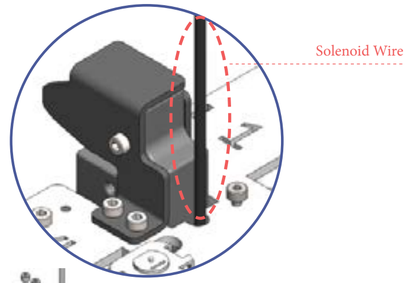


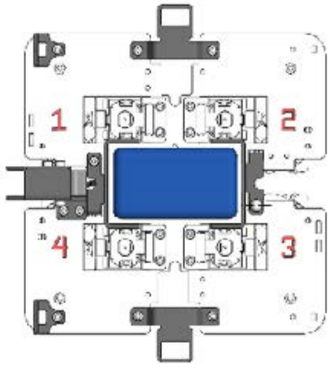










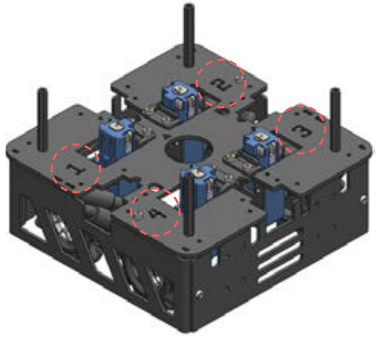


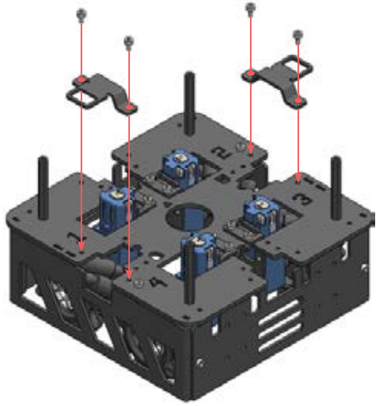
Pay attention to the numbers and their positions in relation to the parts being attached.

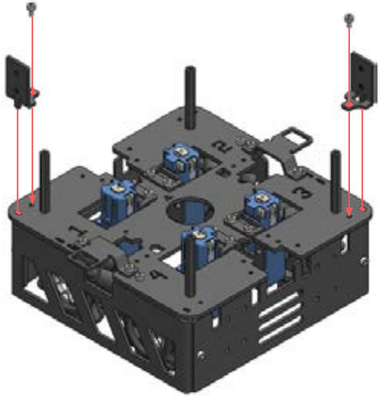
Check that the parts have been attached in the right location.

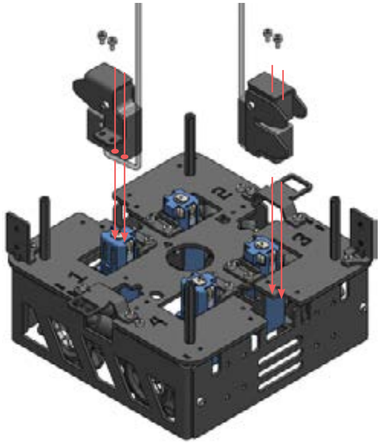
A6 module 3 mechanical sub-assembly

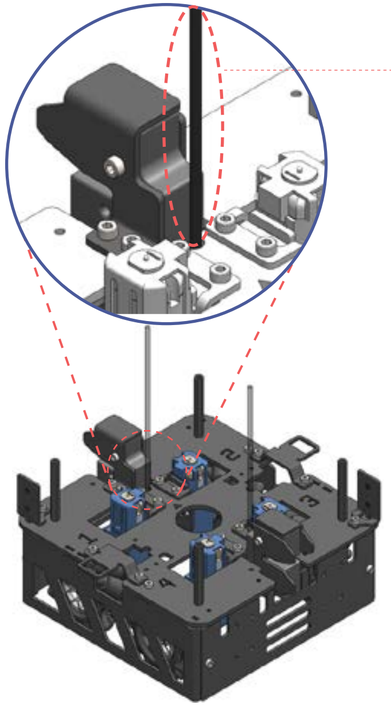
- Hinge mount (2)
- Solenoid catch (2)
- Solenoid latch SA (2) from A.3
- Base Module SA (1) from A.2
- M3 x 5 (10)

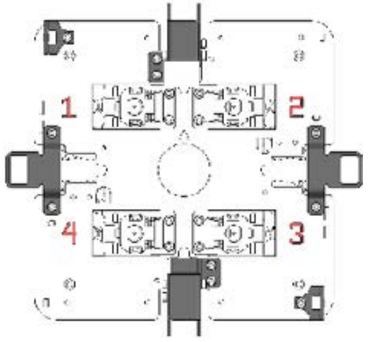










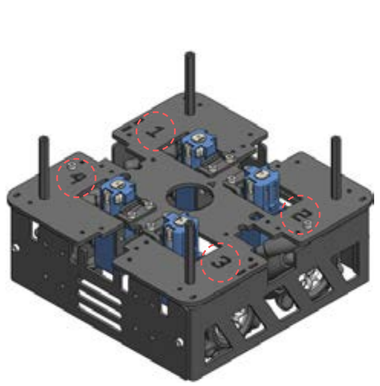


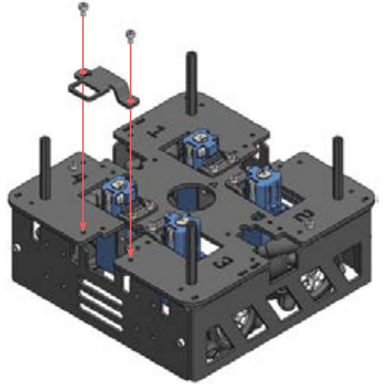
Pay attention to the numbers and their positions in relation to the parts being attached.

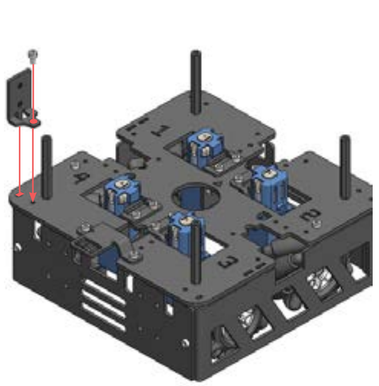
Check that the parts have been attached in the right location, in relation to the numbers.

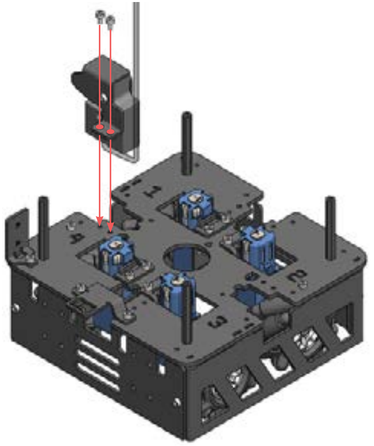
A.7 module 4 mechanical sub-assembly

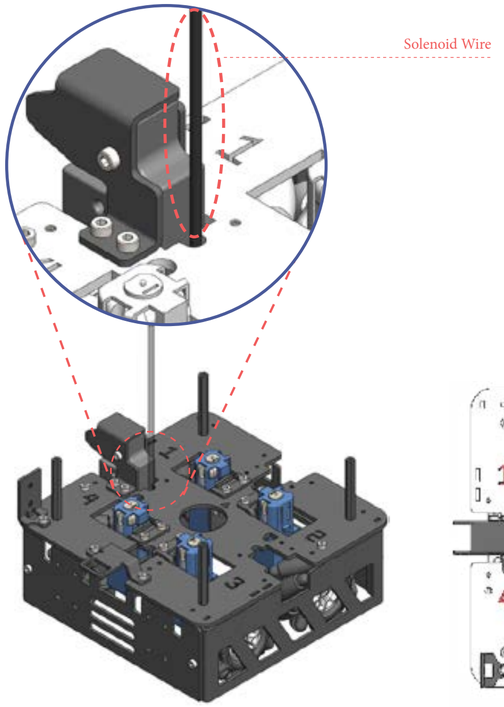
	Hinge mount	(1)
	Solenoid catch	(1)
	Solenoid latch SA from A.3	(1)
	Base Module SA from A.2	(1)
	M3 x 5	(5)

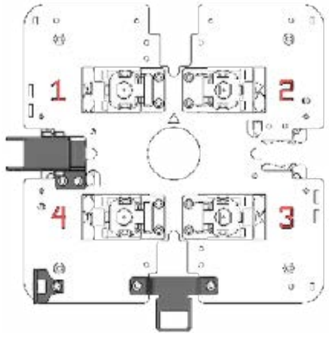










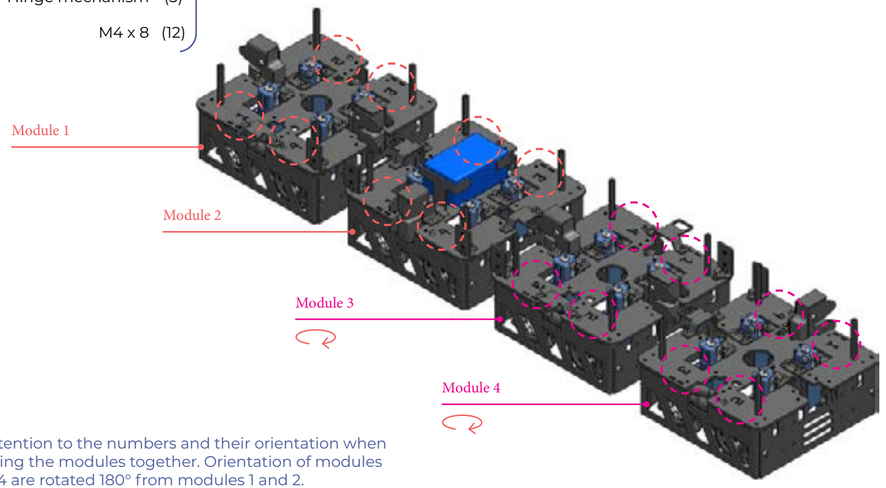


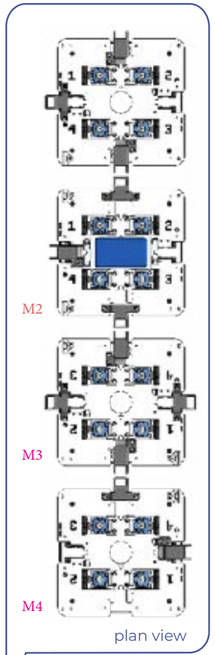
Pay attention to the numbers and their positions in relation to the parts being attached.

Check that the parts have been attached in the right location.

A8 full mechanical assembly

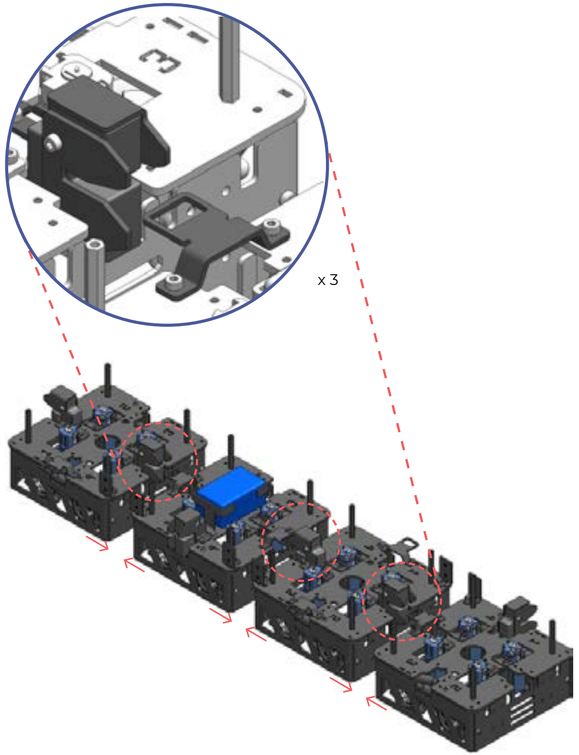
Module 1 (1) from A.4
Module 2 (1) from A.5
Module 3 (1) from A.6
Module 4 (1) from A.7
Hinge mechanism (3)
M4 x 8 (12)

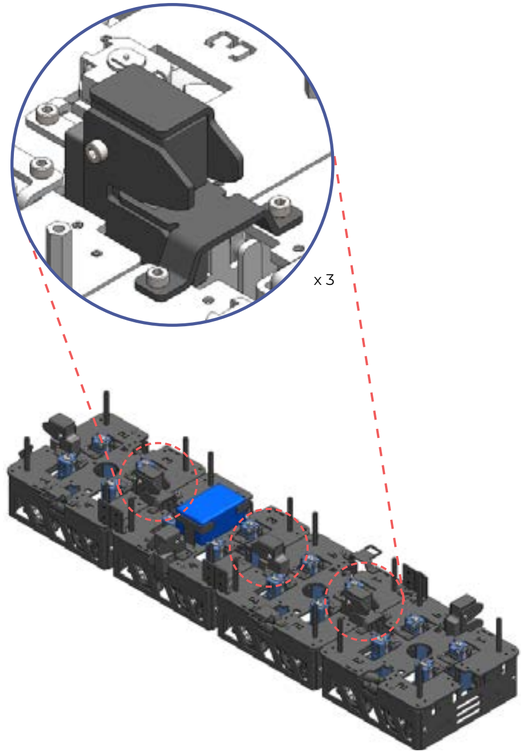


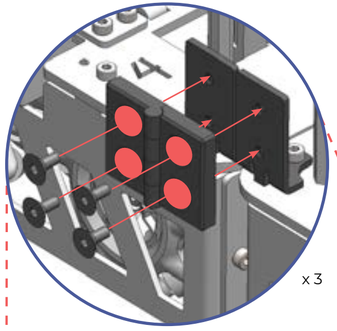


plan view

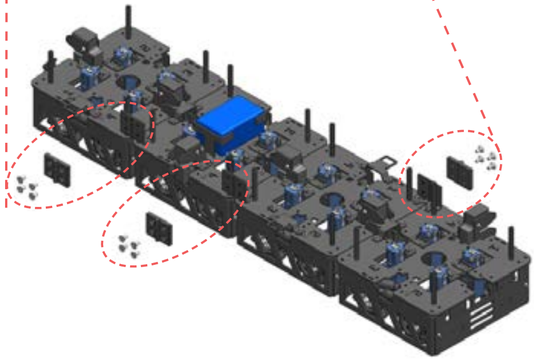
Pay attention to the numbers and their orientation when attaching the modules together. Orientation of modules 3 and 4 are rotated 180° from modules 1 and 2.

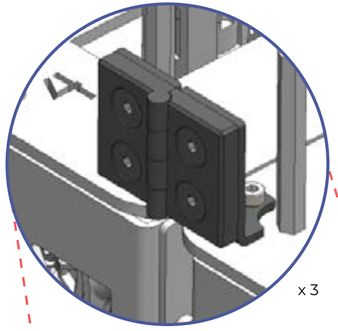




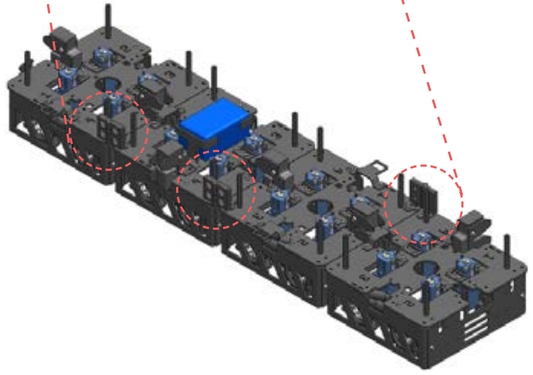


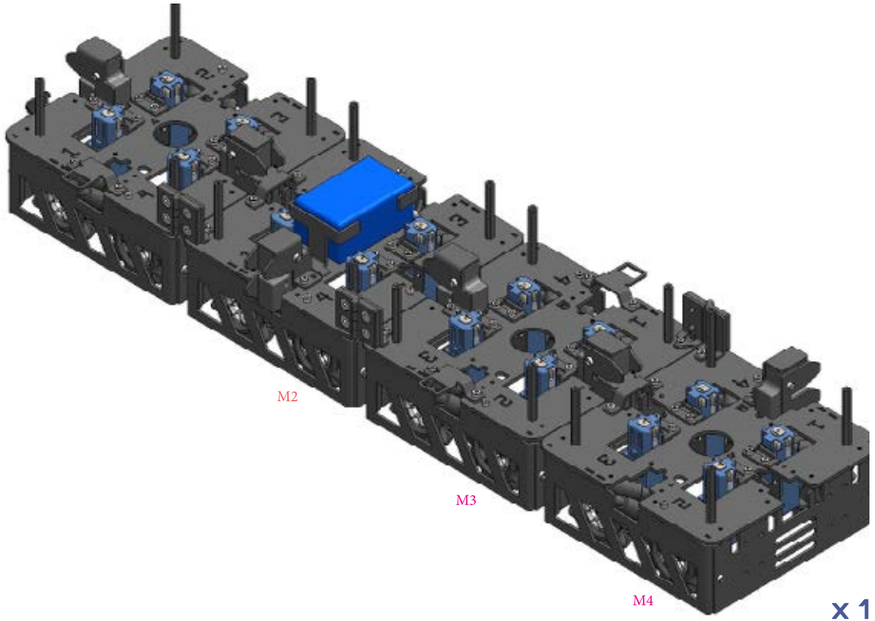
x 3





x 3





x 1

Check all the positions of solenoids, solenoid catches, hinge mounts before proceeding to section B.

A mechanical assembly completed

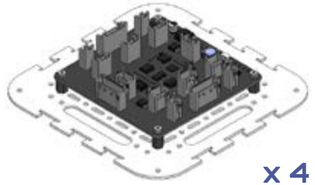
B1 e-tray sub-assembly

Acrylic base plate (4)

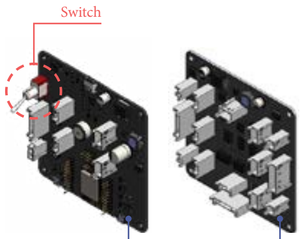
Slaveboard (4)

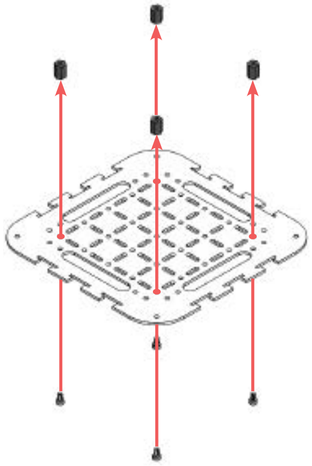
Hex F-F M3 10mm (16)

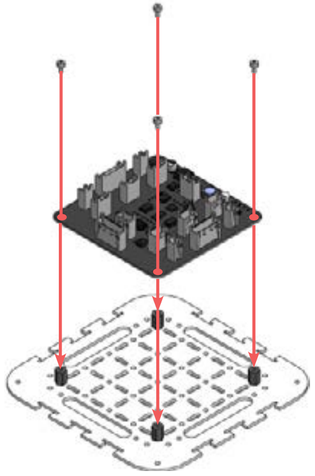
M3 x 5 (32)



x 4







Make sure that you are attaching the slaveboards and not the masterboard.

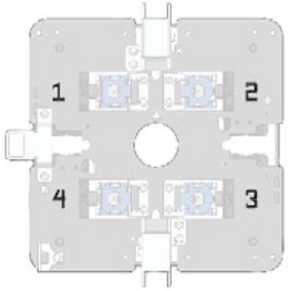
How to differentiate between masterboard and slaveboards:
- Masterboard has a special switch

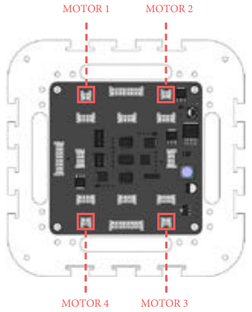
B2 e-tray onto mechanical assembly

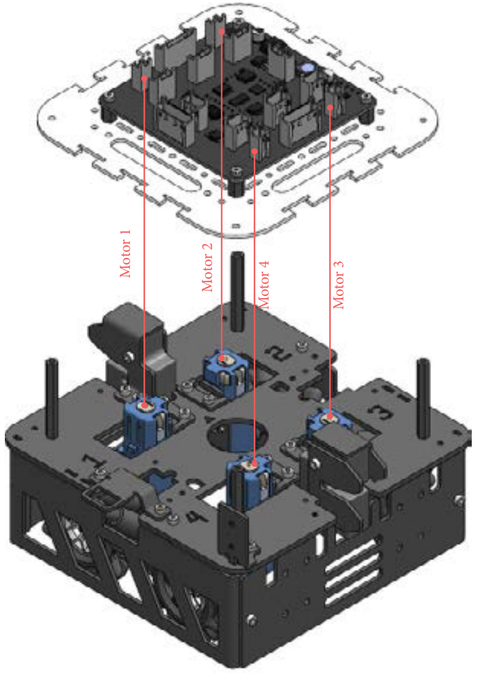
e-tray SA (4)
from B.1

full mechanical SA (1)
from A.8

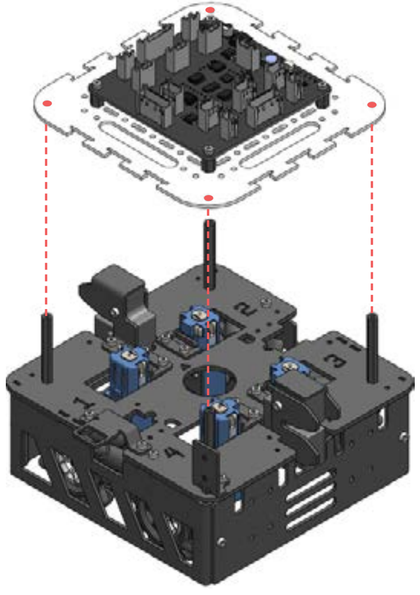
Hex M-F M3 45mm (16)

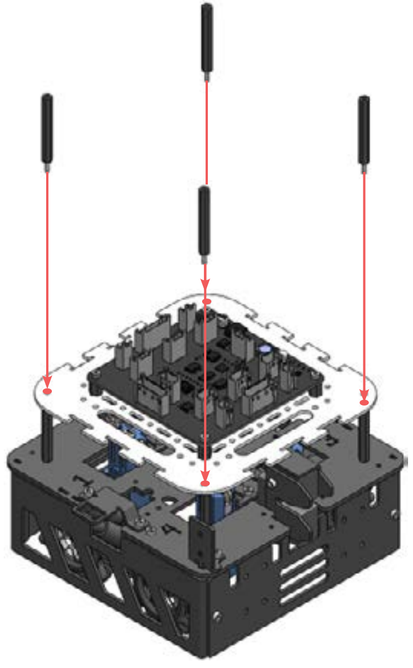




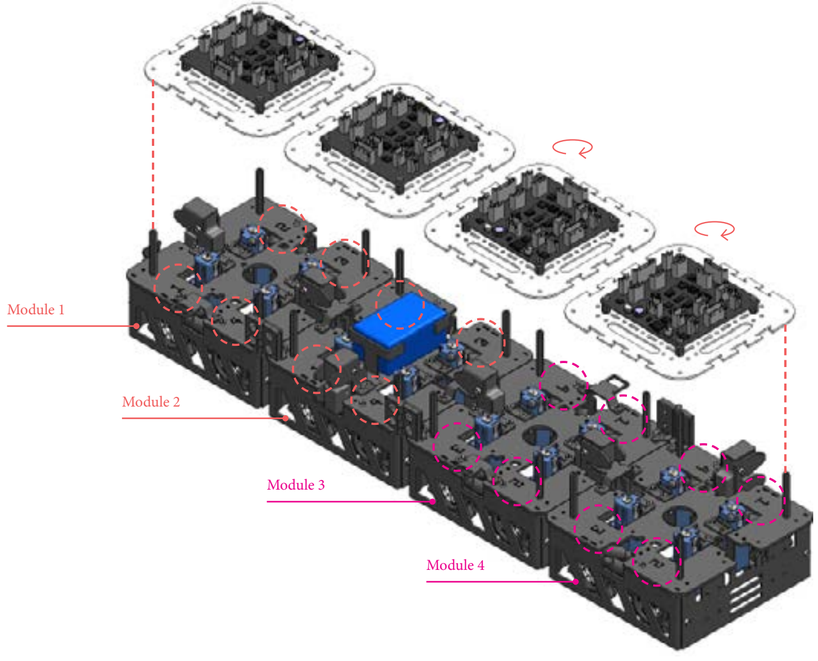


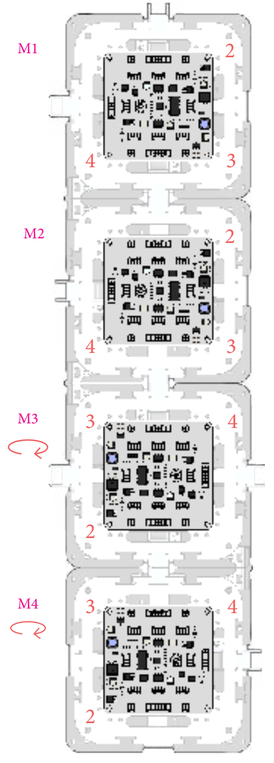
Orientate e-tray SA and base module as shown on the right.
Motor 1 connector on e-tray should be on top of Motor 1 of base module.
Same goes for Motor 2, 3 and 4.



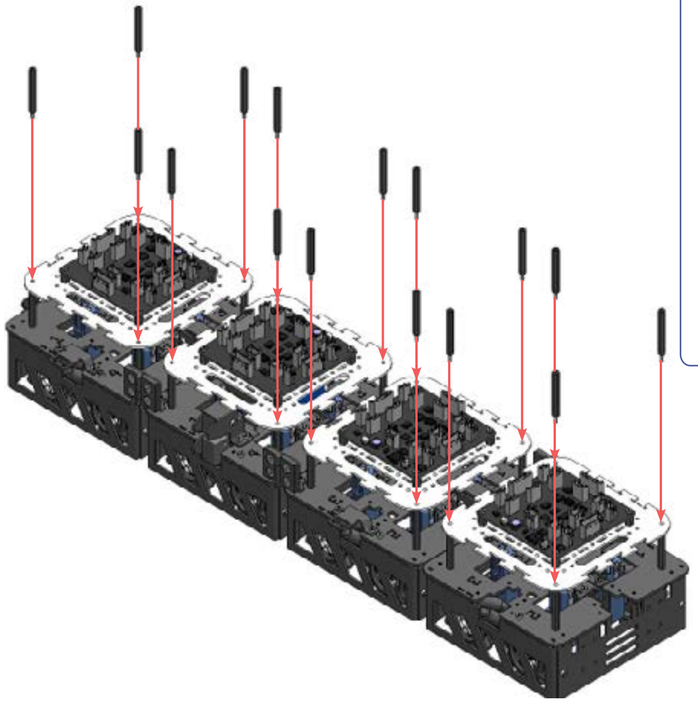


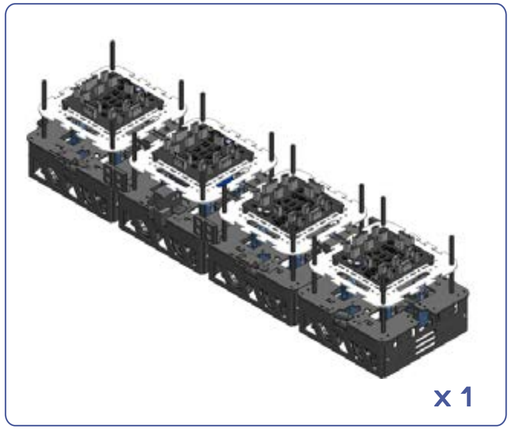
Before attaching the e-tray SA, please flip all the cables and connectors for motors and solenoids (not shown in diagram for clarity) out, for easy attachment later on.





Orientation of modules 3 and 4 are rotated 180° from modules 1 and 2. Therefore, make sure that the e-tray SAs for module 3 and 4 are also rotated 180° to correspond to the motor orientation as numbered.

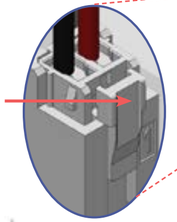




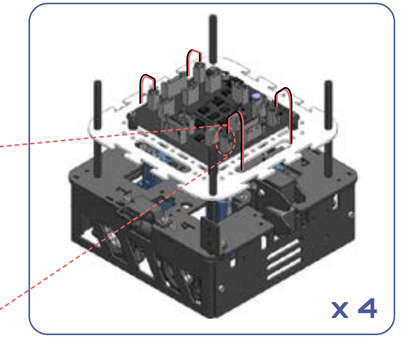
8.3 all module motor cable connection

motor cables (16)
attached to motor

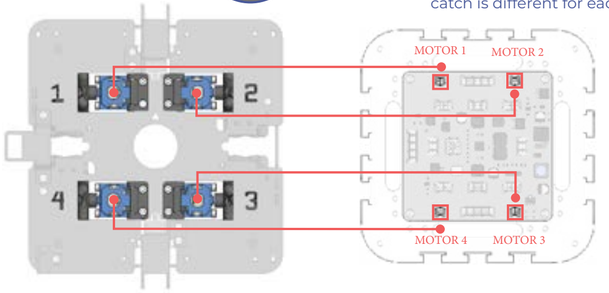
module SA (4)
attached to full assembly



To unplug cable:
Press and pull out
the connector

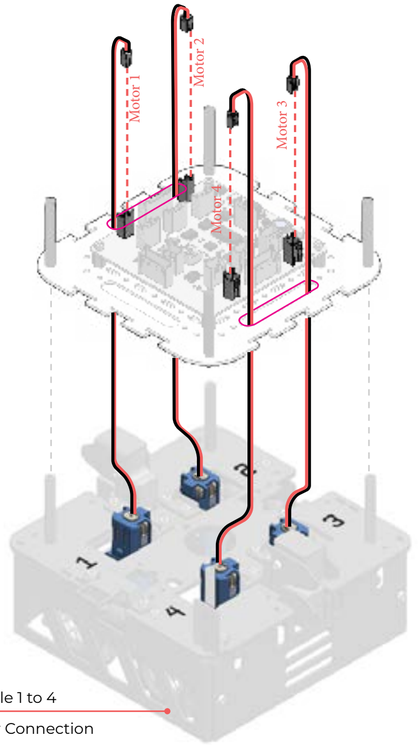


Note: Position of solenoid latch and solenoid catch is different for each module



Make sure that Motor 1 is connected to Motor 1 connector on Slaveboard; the same goes for Motor 2, 3 and 4.

Motor cable connection is the same for all 4 modules



Module 1 to 4

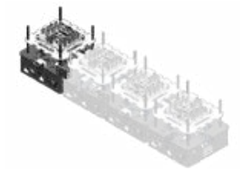
Motor Connection

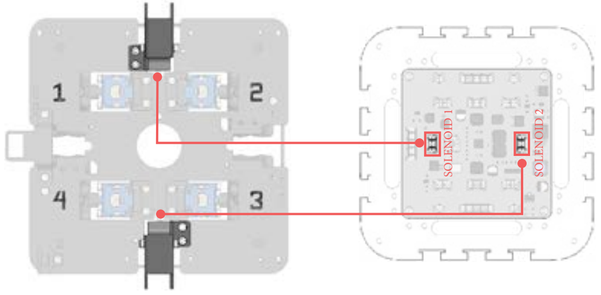
Opening to pass wire through

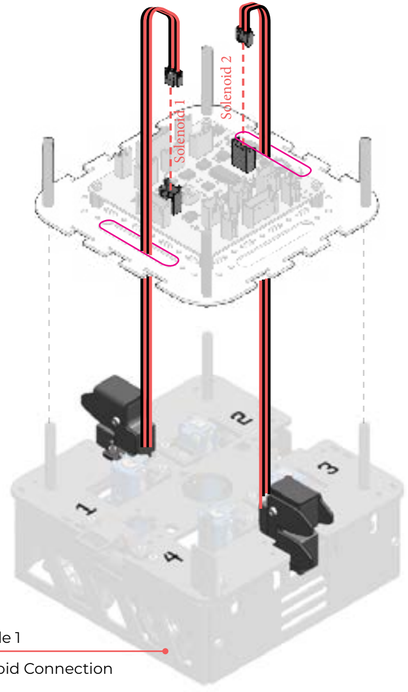
B4 module 1 solenoid cable connection

solenoid cables (2)
attached to solenoids

module 1 SA (1)
attached to full assembly







Module 1

Solenoid Connection

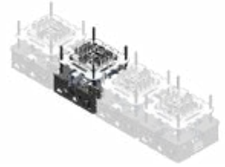
Make sure to connect the solenoid to the labelled solenoid connector exactly as in the diagram below.

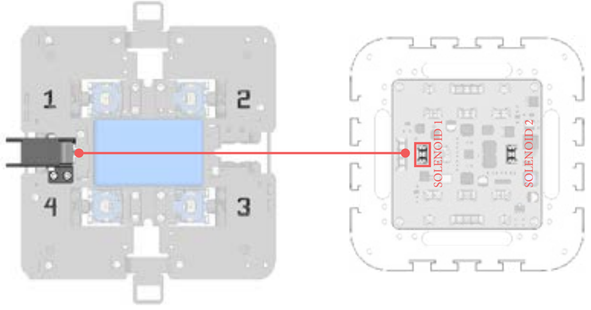
Opening to pass wire through

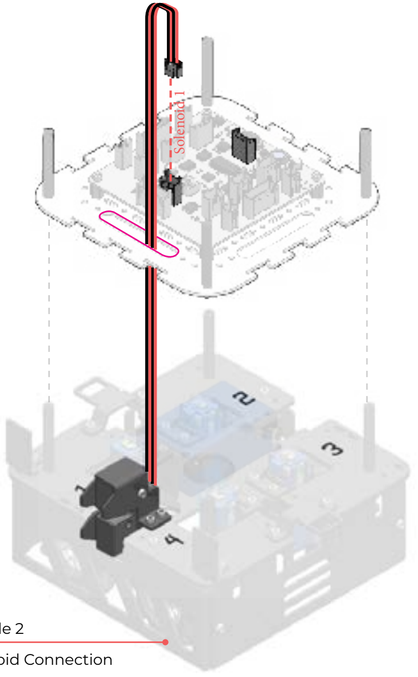
B5 module 2 solenoid cable connection

solenoid cables (1)
attached to solenoids

module 2 SA (1)
attached to full assembly







Module 2

Solenoid Connection

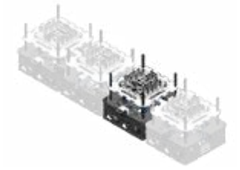
Make sure to connect the solenoid to the labelled solenoid connector exactly as in the diagram below.

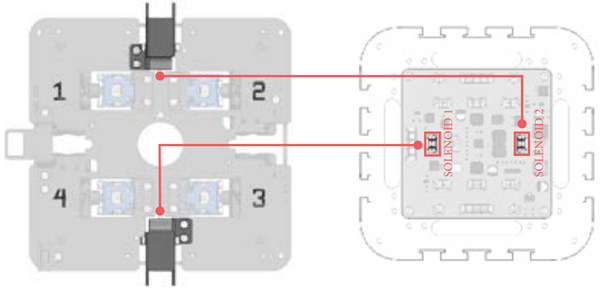
Opening to pass wire through

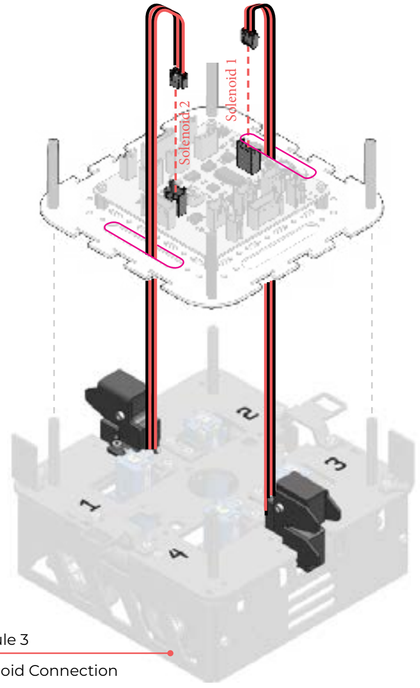
B6 module 3 solenoid cable connection

solenoid cables (2)
attached to solenoids

module 3 SA (1)
attached to full assembly







Module 3

Solenoid Connection

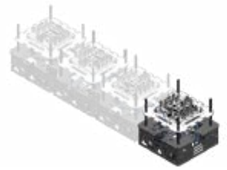
Opening to pass wire through

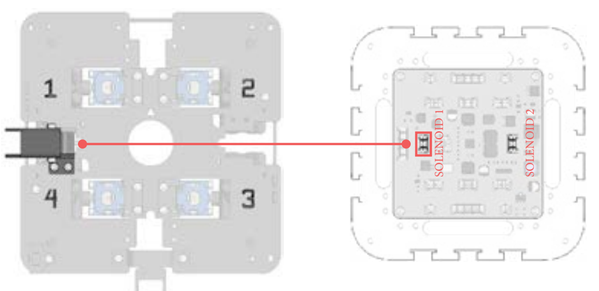
Make sure to connect the solenoid to the labelled solenoid connector exactly as in the diagram below.

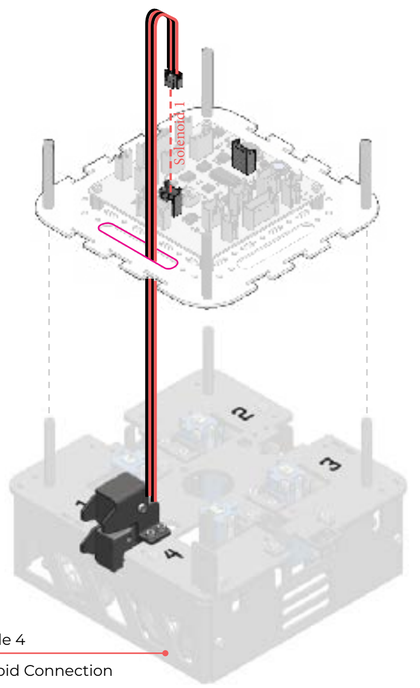
B7 module 4 solenoid cable connection

solenoid cables (1)
attached to solenoids

module 4 SA (1)
attached to full assembly







Module 4

Solenoid Connection

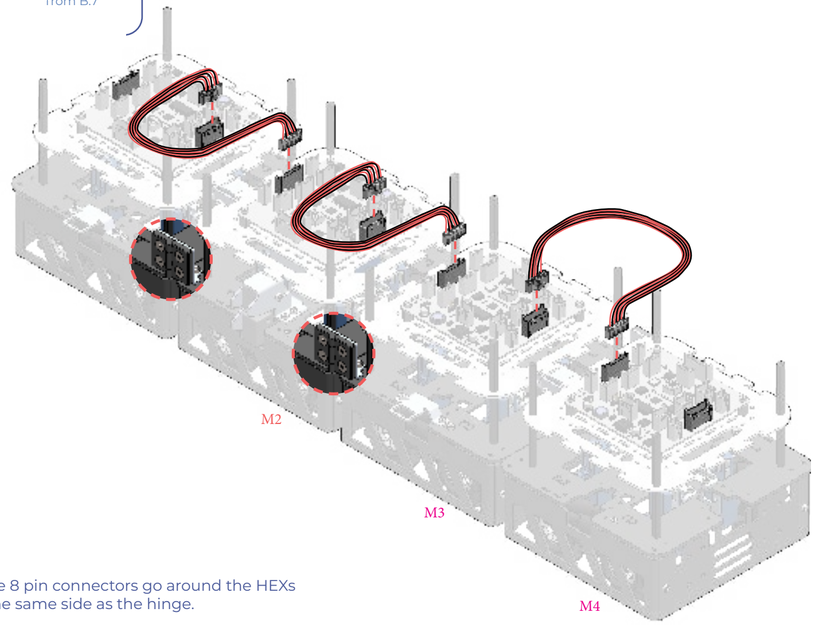
Opening to pass wire through

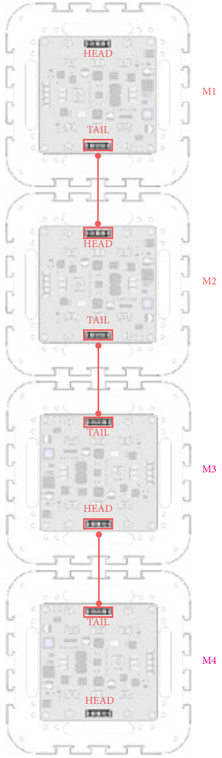
Make sure to connect the solenoid to the labelled solenoid connector exactly as in the diagram below.

B8 inter-module cable connection

8-pin connectors (3)

full assembly (1)
from B.7



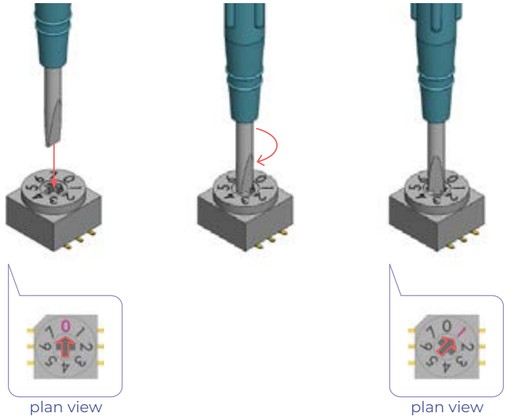


Make sure the 8 pin connectors go around the HEXs that are on the same side as the hinge.

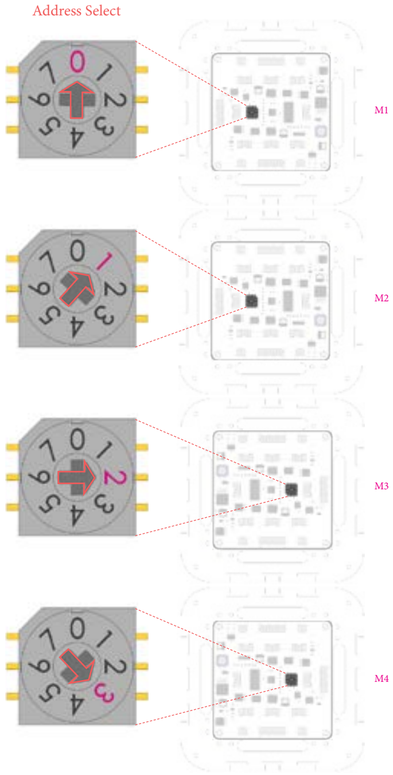
B9 address selection

full assembly (1)
from B.8

ceramic screwdriver (1)

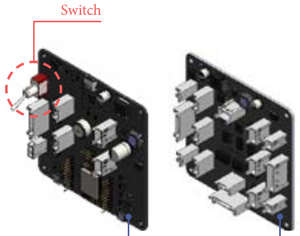


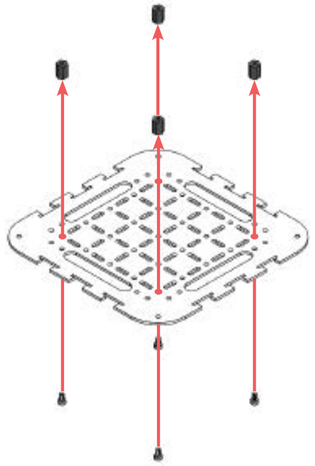
Use the ceramic screwdriver to adjust the rotary switch and select the address for all 4 modules.
Module 1: Address 0, Module 2: Address 1,
Module 3: Address 2, Module 4: Address 3

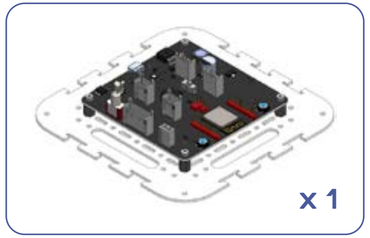


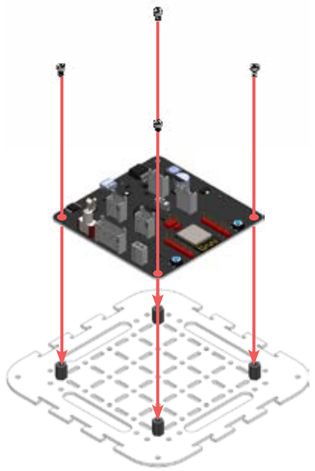
B10 masterboard e-tray sub-assembly

- Acrylic base plate (1)
- Masterboard (ESP32) (1)
- Hex F-F M3 10mm (4)
- M3 x 5 (8)







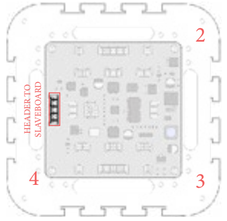


Make sure that you are attaching the masterboard and not the slaveboards.

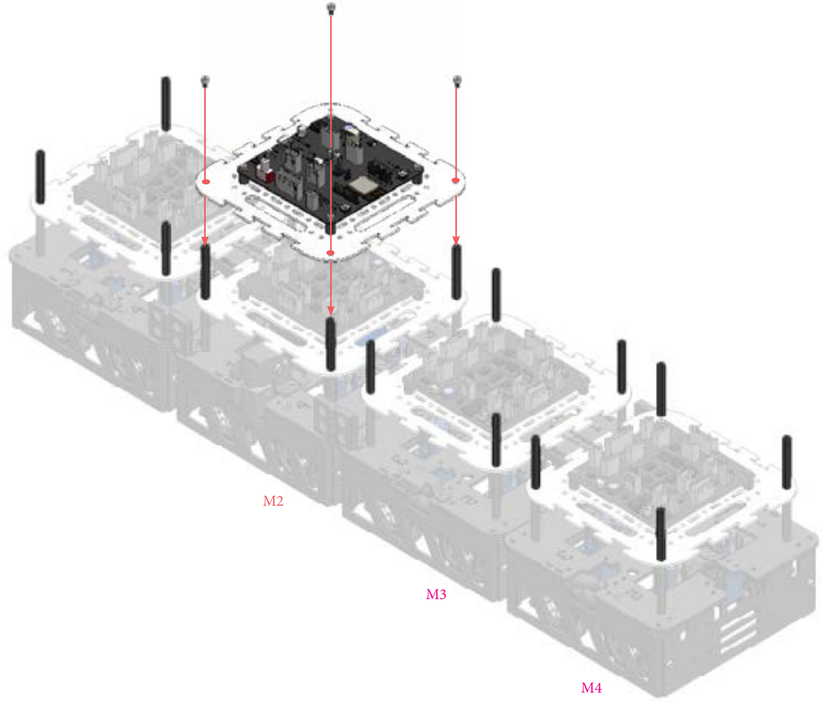
How to differentiate between masterboard and slaveboards:
- Masterboard has a special switch

B11 masterboard e-tray onto main assembly

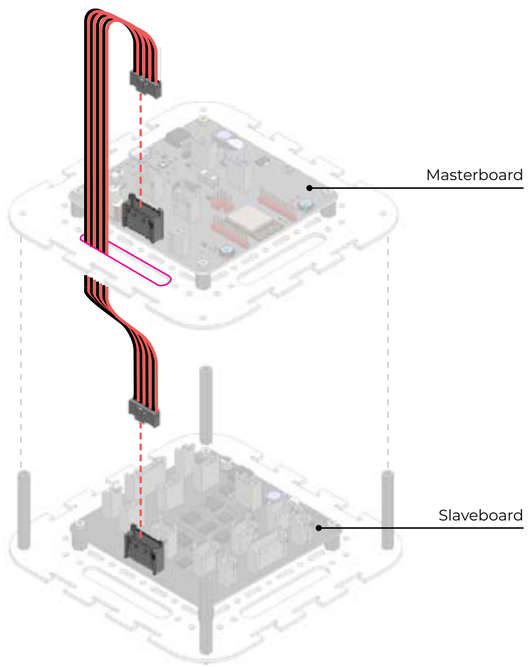
- masterboard e-tray SA (1) from B.10
- full mechanical SA (1) from B.9
- 8-pin connector (1)
- M3 x 5 (4)

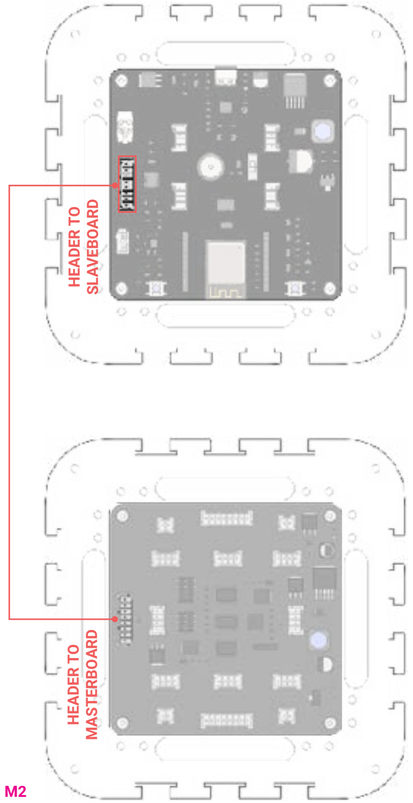


Align the header to slaveboard connector on the masterboard to face the side connecting Motor 1 and 4.



“DO NOT PLUG-IN / UNPLUG THE CONNECTOR CABLES WHILE THE POWER SUPPLY IS ACTIVELY PROVIDED (EITHER THROUGH BATTERY/ USB)”



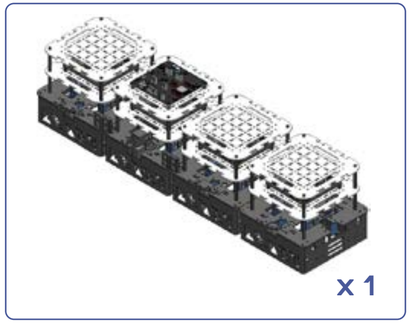


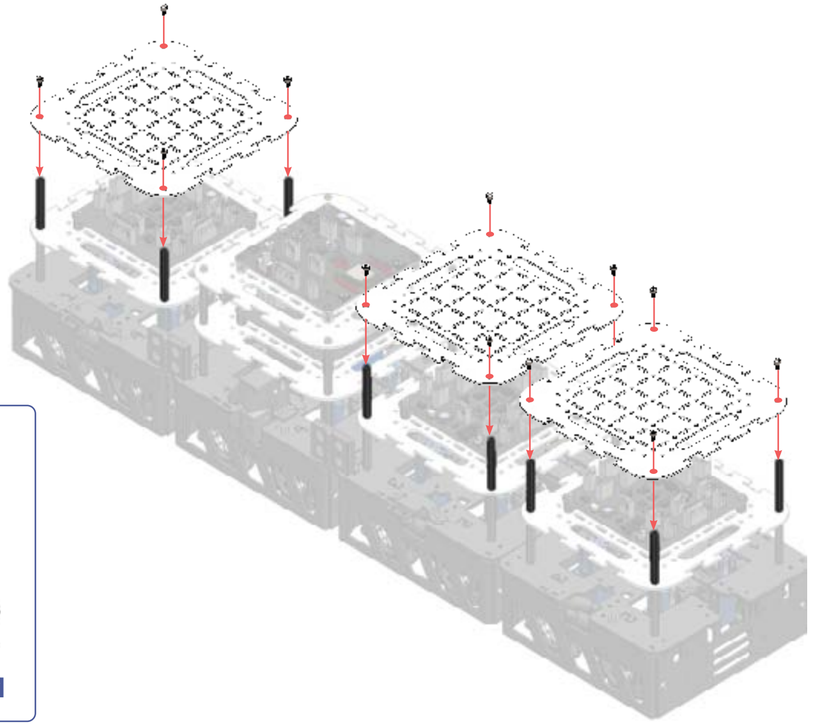
B 12 attach acrylic covers

Acrylic base plate (3)

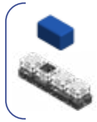
full mechanical SA (1)
from B.11

M3 x 5 (12)



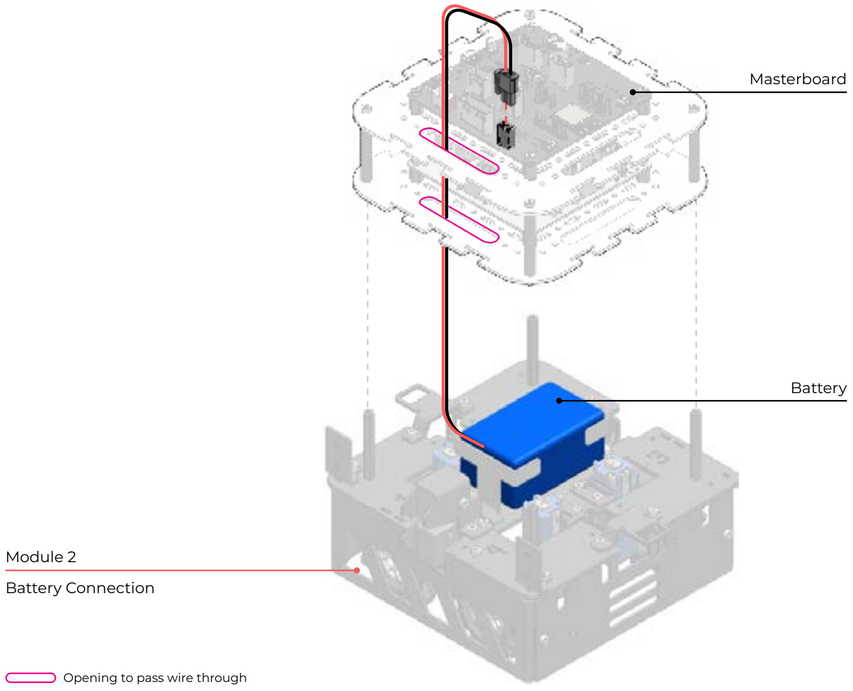


B 13 connect battery to masterboard

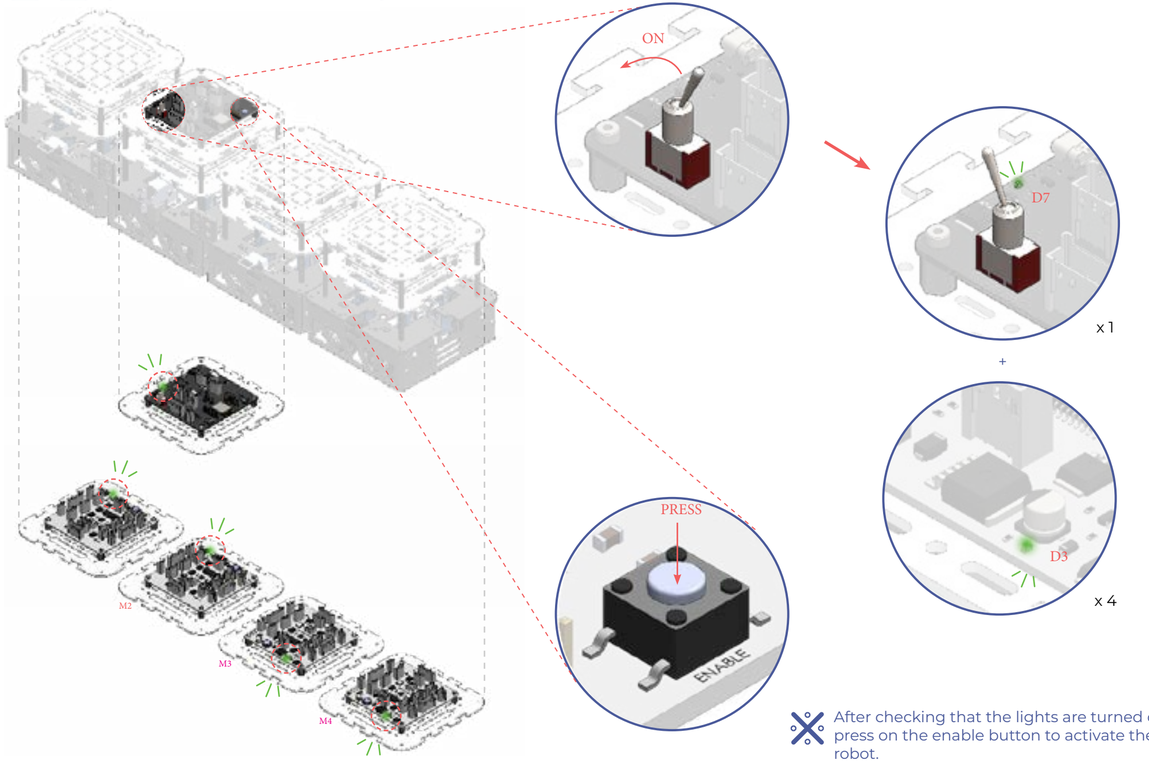


Li-ion Battery (1)

full mechanical SA (1)



B 14 check connection

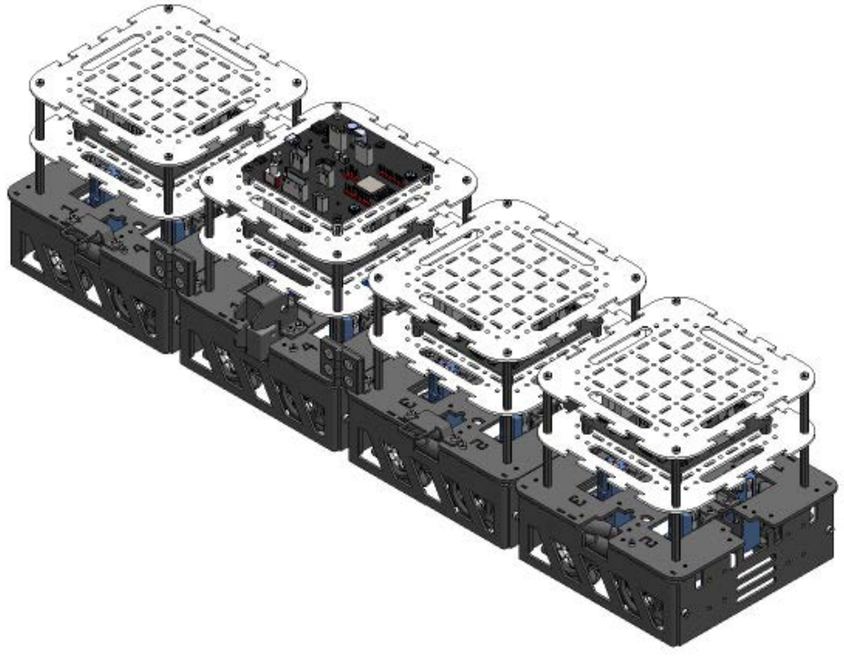


After checking that the lights are turned on, press on the enable button to activate the robot.

B electronic assembly completed

smorphi is ready!

next step: connect with app



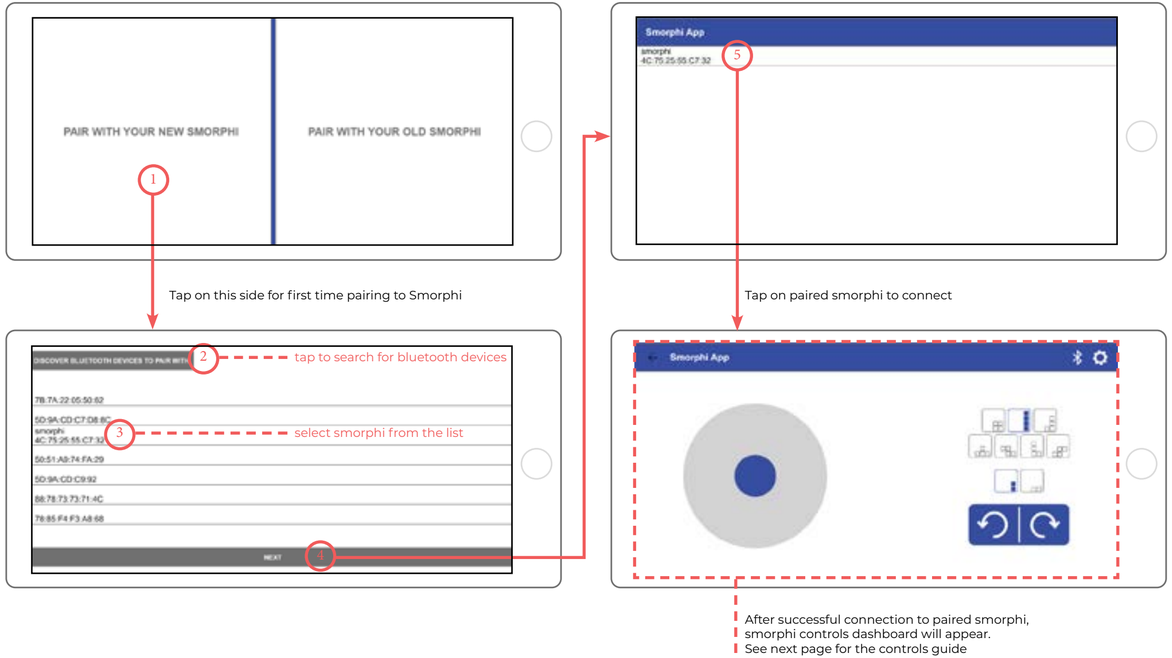
app

1. App Download.

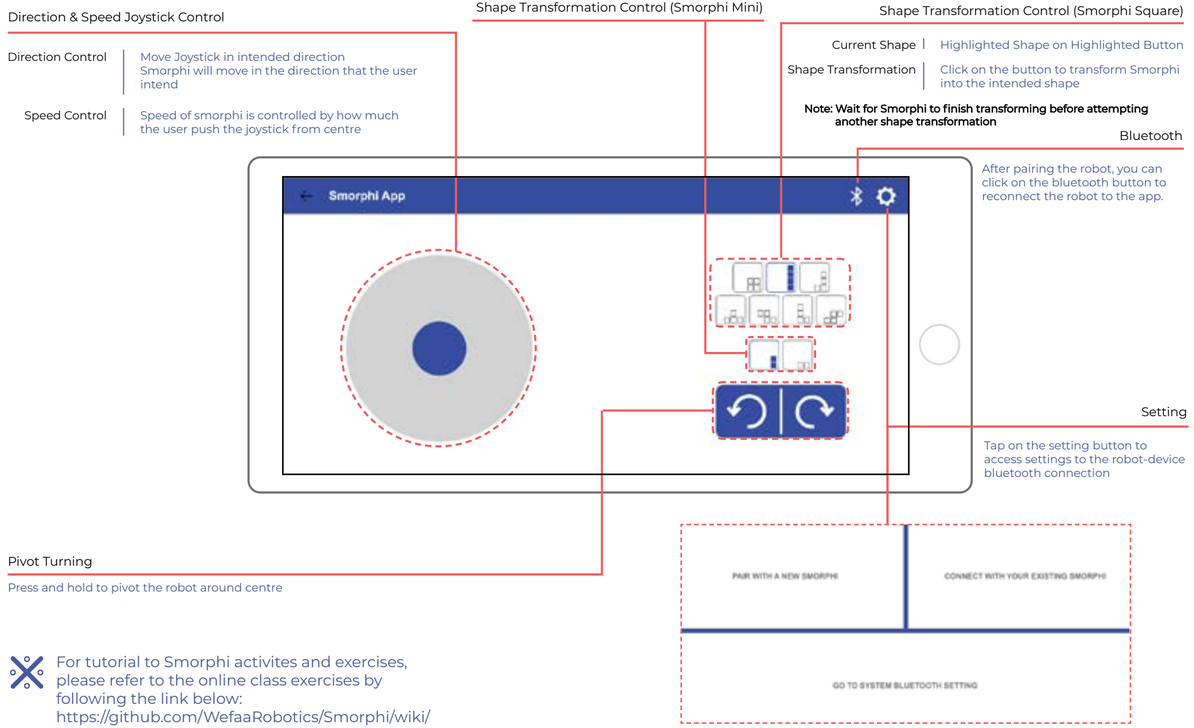
Not all devices are compatible now.
See the table below to check if your device is compatible with the Smorphi app.

Smorphi App Information	
Available Platforms	Android
Download from	Google Play
App Icon & Name	smorphi
System Requirements OS Requirements	Android 6+ Bluetooth 4.0+

2. Bluetooth Connection. Turn on Smorphi and the Bluetooth of your smart device. Tap on Smorphi app icon to launch application.



3. Smorphi controls dashboard guide.



For tutorial to Smorphi activites and exercises, please refer to the online class exercises by following the link below:
https://github.com/WefaaRobotics/Smorphi/wiki/

sensors

sound sensor (x2)

Sound sensor measures volume of sound. Onboard potentiometer* can be used to tune the range of sensing.
Possible applications: sound-triggered shape transformation or sound-triggered locomotion.

temperature sensor (x1)

Temperature sensor measures surrounding temperature, with a range of -55°C to 125°C.

IR sensor (x4)

IR sensors comes with 2 different modes, toggled by the switch onboard the sensor itself. One IR is front-facing and can be used to detect obstacles ahead. The other IR faces the ground and can be used for path tracking.

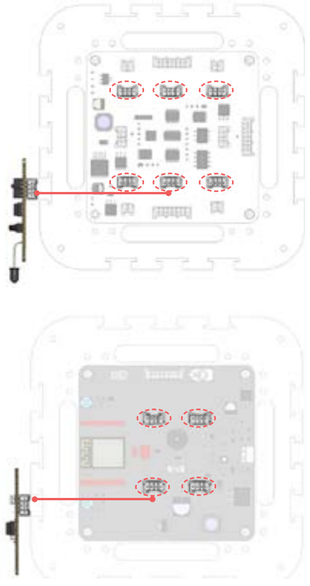
Pixy2 camera (x1)

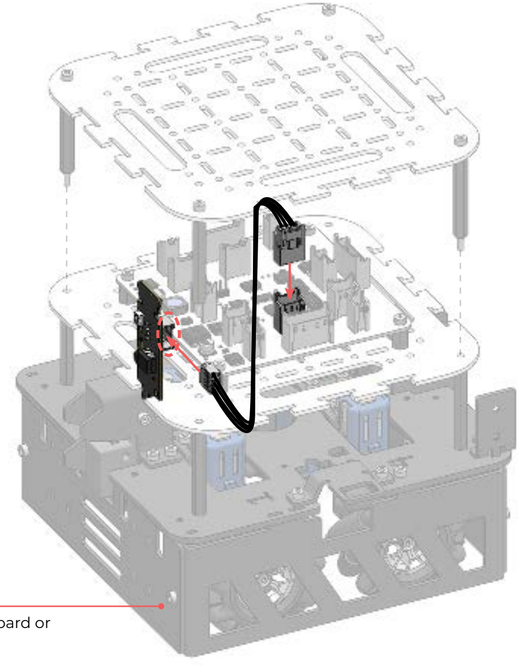
Pixy2 Camera is able to colour code, detect and track lines and intersections, and learn to detect objects taught to it.

For sensor related activities and implementation, please refer to the online class exercises by following the link below:
https://github.com/WefaaRobotics/Smorphi/wiki/Robot-Exercises

Tutorial on how to operate the potentiometer can be found by following the link below:
https://github.com/WefaaRobotics/Smorphi/wiki/Exercise-6

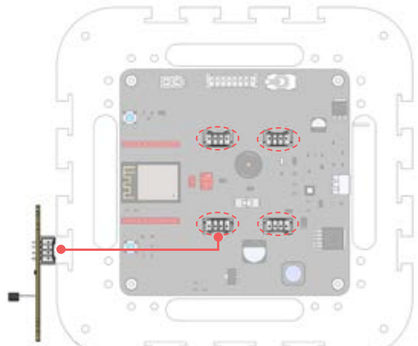
sound/IR sensor wiring

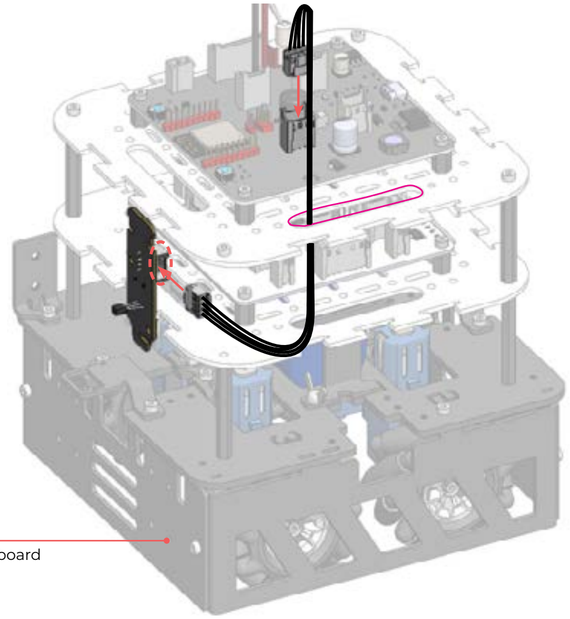




Sound/IR sensor can be connected to any of the 6 sensor ports on the slaveboard (top) or any of the 4 sensor ports on the masterboard (bottom).

temperature sensor wiring

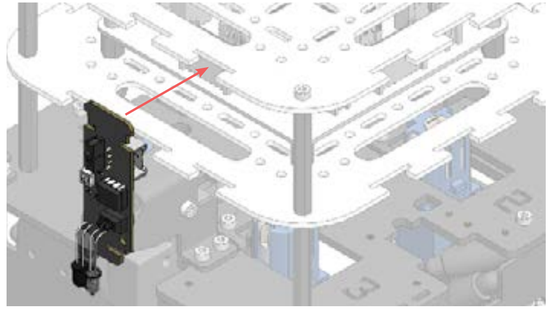


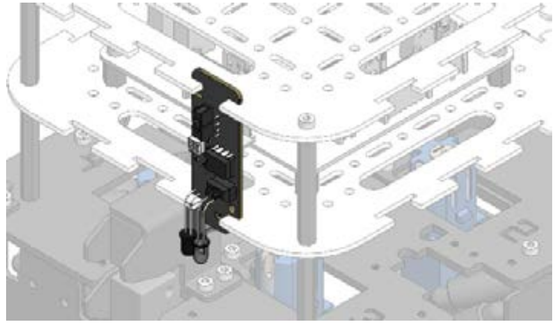


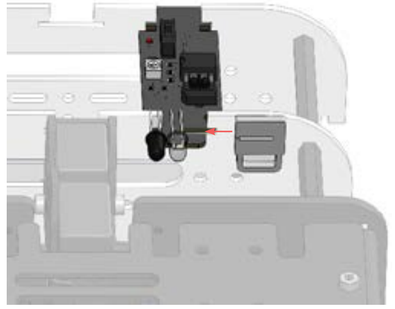
Temperature sensors can only be connected to any of the 4 sensor ports on the masterboard.

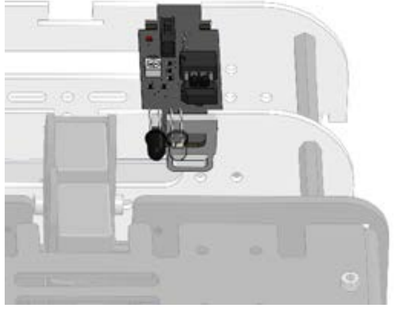
Opening to pass wire through

sensor position 1



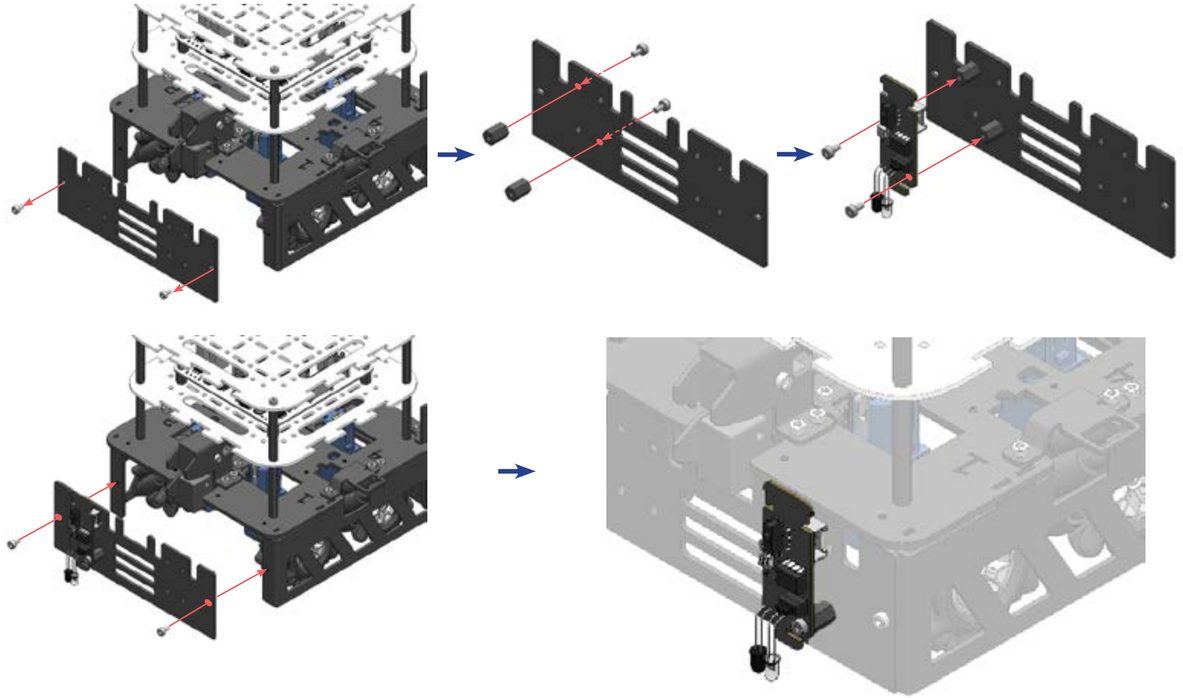






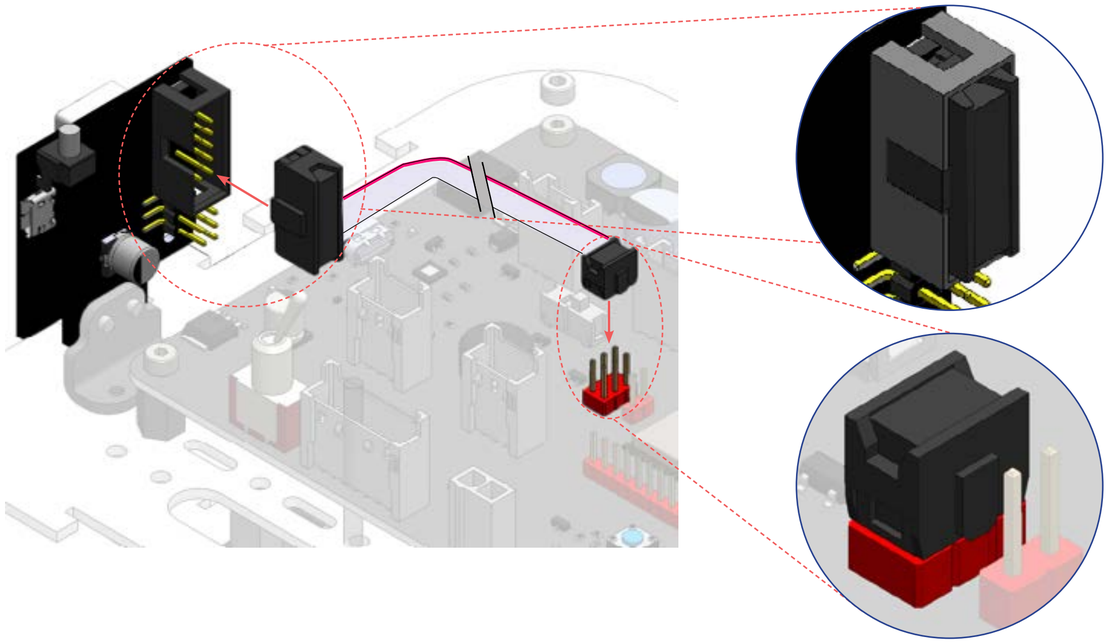
Sensors can be secured to the robot using the sensor lock provided.

sensor position 2



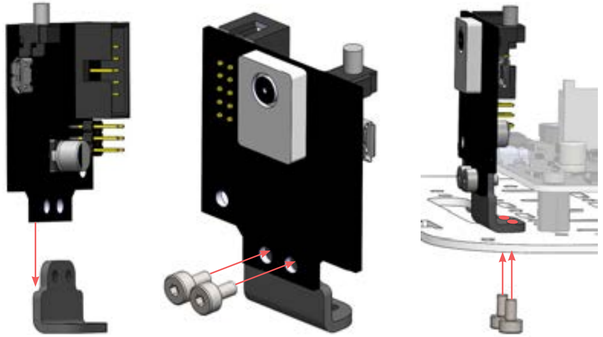
Sensors can also be attached at the skirt panel of the robot.

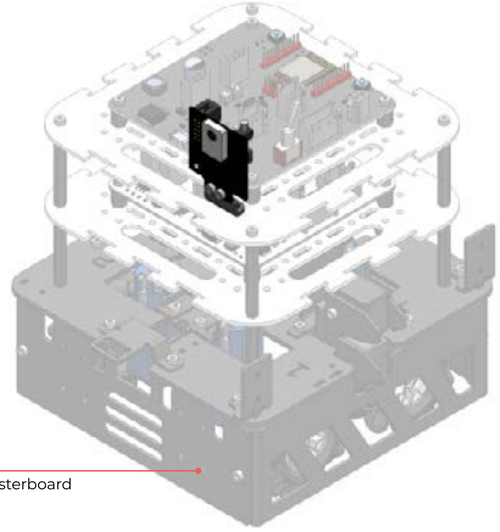
pixycam wiring



Use the flat ribbon cable to connect the pixycam to the masterboard
6 pin side to the masterboard
10 pin side to the pixycam

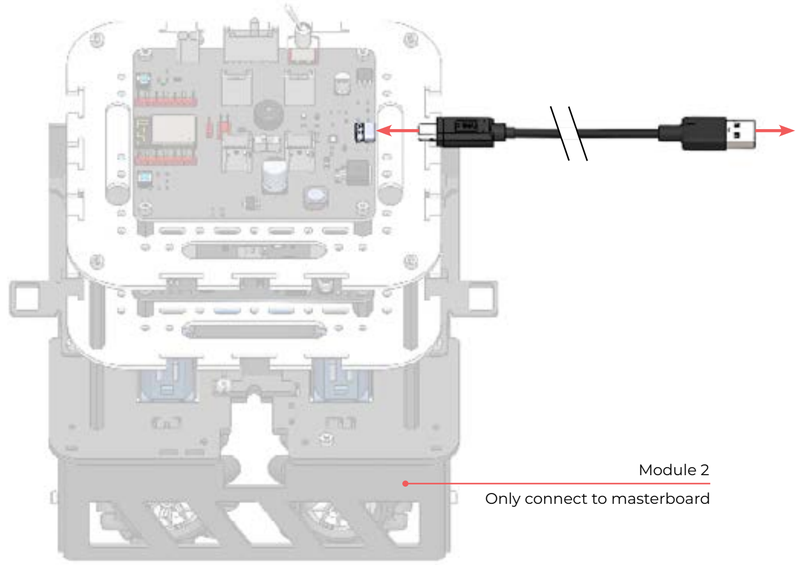
(mounting the pixycam)





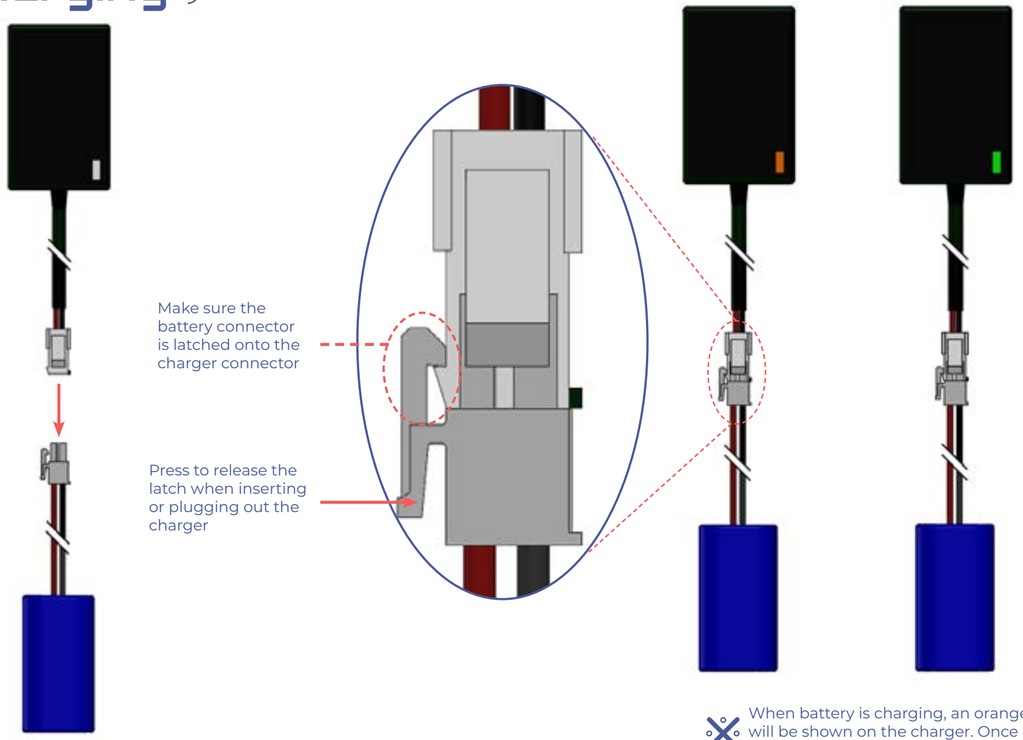
Pixycam can be mounted on anywhere on the acrylic board.

(connect to laptop)



Plug in the USB-C cable as shown above to connect the masterboard to the computer.
It allows us to upload our code from our computer onto the masterboard.

charging



When battery is charging, an orange light will be shown on the charger. Once battery is fully charged, a green light will be shown

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