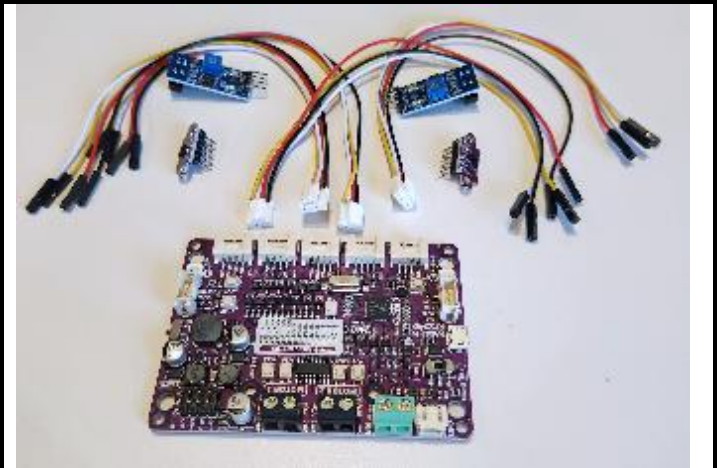


Assembly instructions for BB1 mini sumo bot. Please consult the parts preparation information before assembly.

1. Lay out the electronics for the robot. This includes the Maker Pi RP2040 board (qty. 1) with grove connector cables (qty. 4), ToF (VL53L0X Time of Flight) sensors (qty. 2), and edge detection (TCRT5000 infrared reflective) sensors (qty. 2).



2. Connect the electronics according to the following list, using the labels on the parts. The Grove port numbers and pins are listed on both the top and the bottom of the Maker Pi board. All sensors have connection labels on them. Note that all references to “left,” “right,” etc. in these instructions refer to the robot’s point of view.

Grove 2

GND -> Right ToF GND

3V3 -> Right ToF VIN

GP2 -> Right ToF SDA

GP3 -> Right ToF SCL

Grove 3

GND -> Left edge detection GND

3V3 -> Left edge detection VIN

GP4 -> Left ToF XSHUT

GP5 -> Left edge detection DO

Grove 4

GND -> Left ToF GND

3V3 -> Left ToF VCC

GP16 -> Left ToF SDA

GP17 -> Left ToF SCL

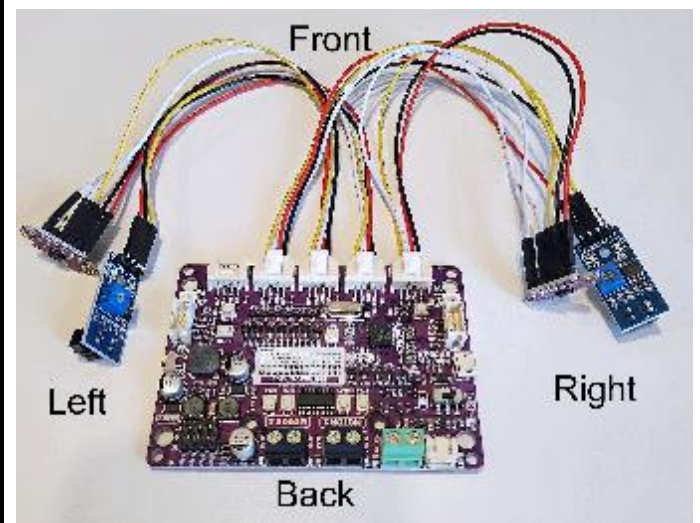
Grove 5

GND -> Right edge detection GND

3V3 -> Right edge detection VCC

GP6 -> Right ToF XSHUT

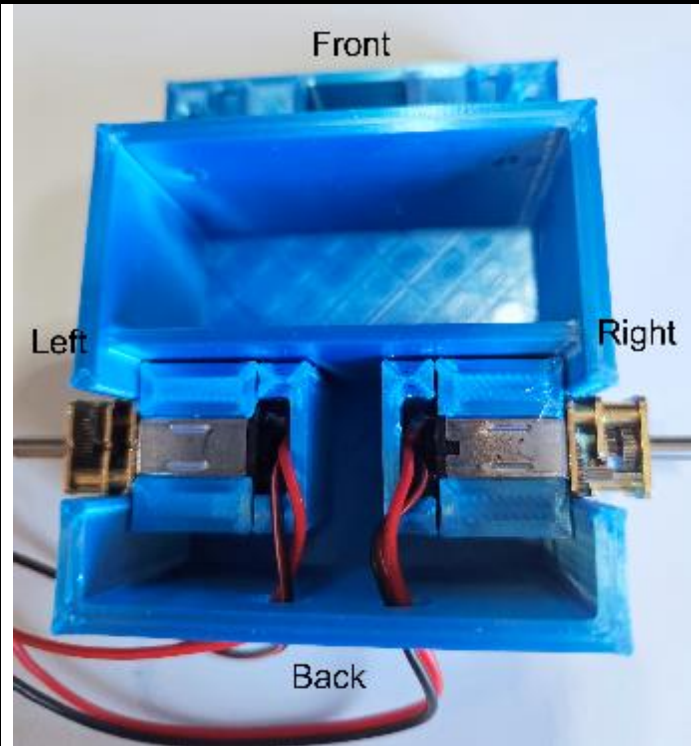
GP26 -> Right edge detection DO



Set the electronics assembly aside while keeping track of the left/right orientation of parts.

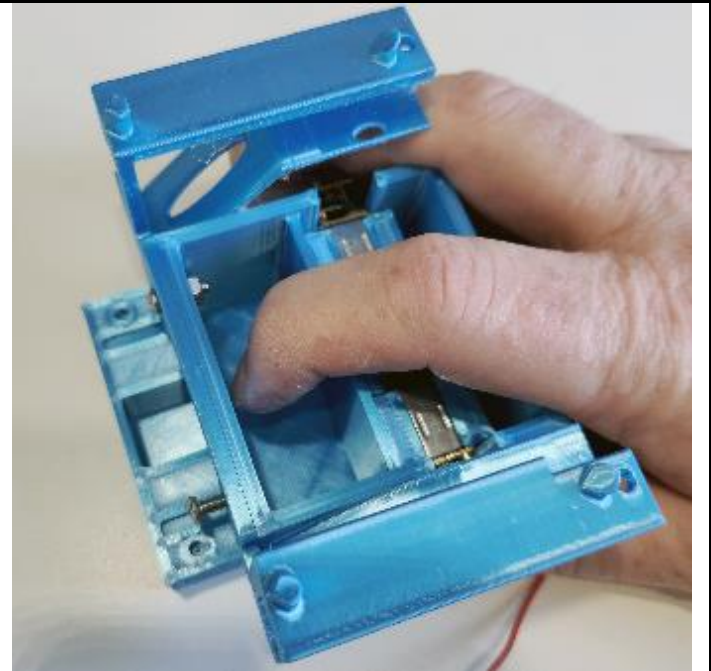
3. Insert the motors into the main body. It doesn't matter which motor goes into which side or which wire color goes in front, but be consistent so that both motors have the same color wire in front.

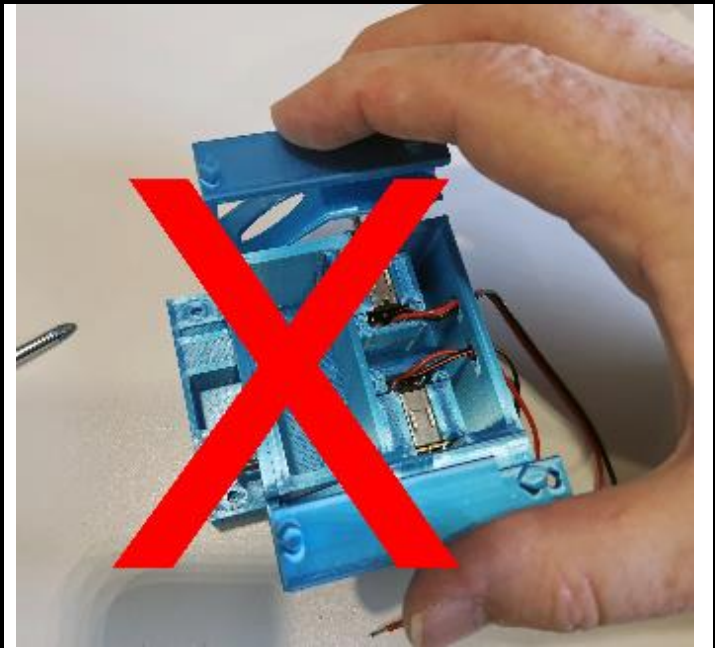
The motors are held in the robot by friction, and it may require some pressure to insert them fully. Hold them by the brass plates on their gearbox while inserting. Ideally the brass plate closest to the silver motor housing should align with the inside of the main body wall, as illustrated. However, as long as it aligns with the outside of the wall installation will be adequate. Forcing the installation could crack the main body. Thread the motor wires up and out of the main body through the supplied holes at the back of the body.



4. Install the fender bar onto the main body with two bolts inserted from the front and secured with nuts from inside the front wall of the main body.

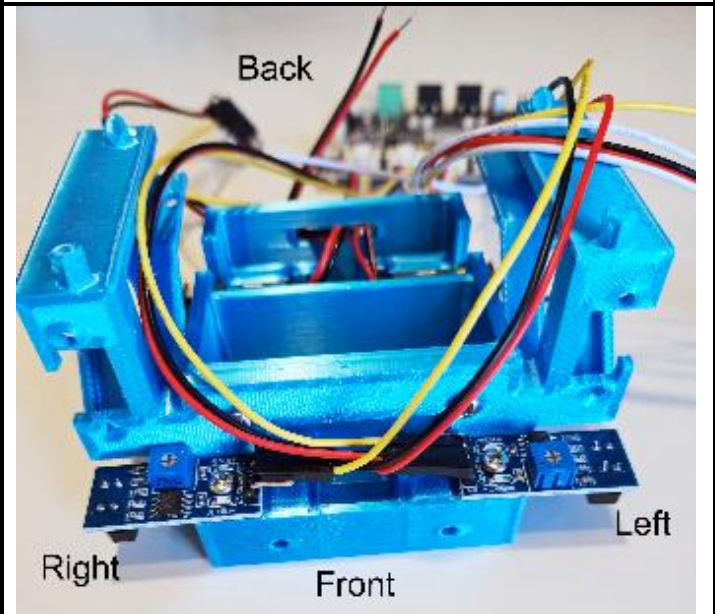
Note that the fender bar is easily bent in some directions and applying pressure in those directions can warp or even break it. Do not squeeze or twist the bar or put pressure on it from the top. Instead always hold it flat against the main body while installing and put any pressure on the main body.





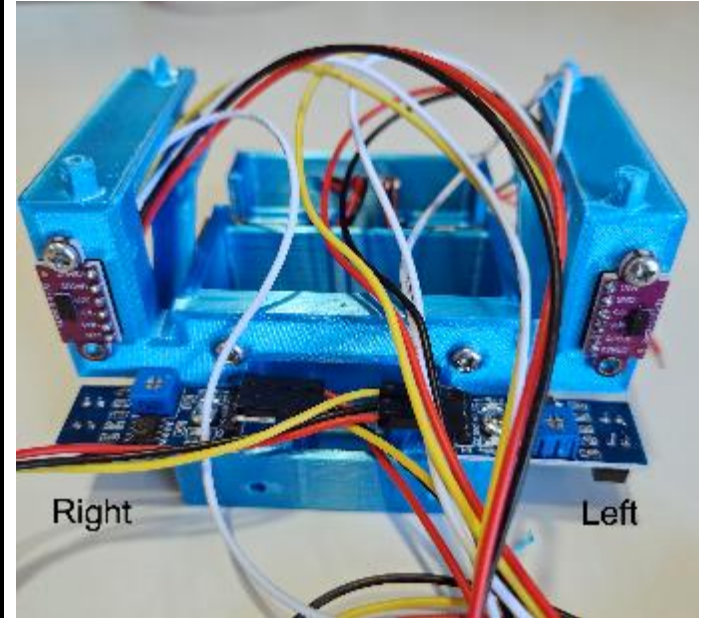
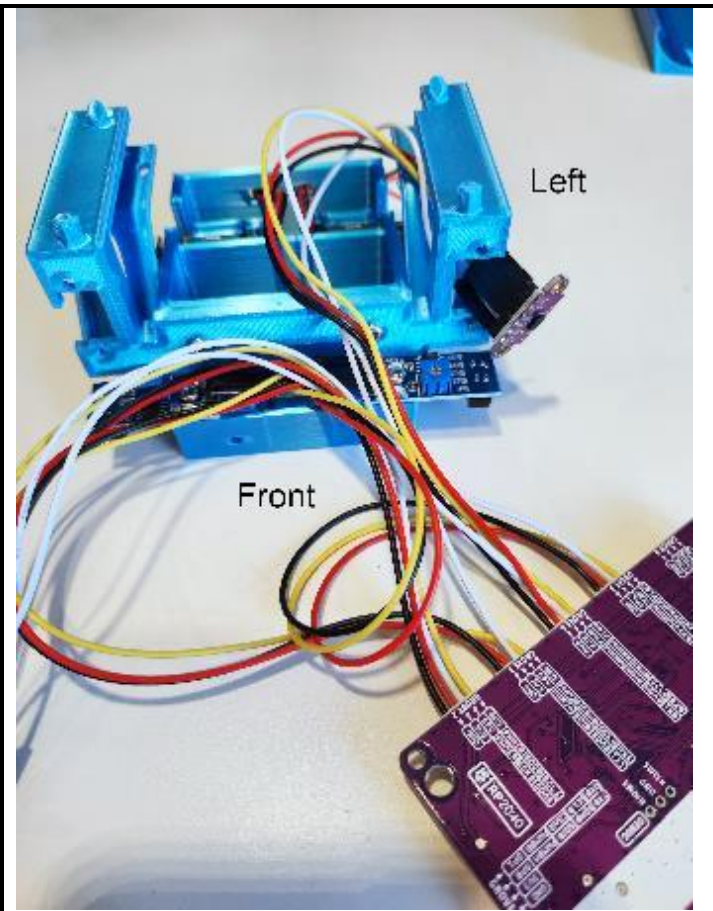
5. If the front ballast box is being used, fill the box and secure the ballast. For example, cover the top of the box with tape (not illustrated).

Install the edge detectors to the main body by bolting them down from the top and securing them underneath with nuts. Bolt the left sensor (attached to Grove port 3) to the left side of the robot and the right sensor to the right side. The blue adjustment screw blocks on the sensors point upward, and one block sits closer to the main body than the other.

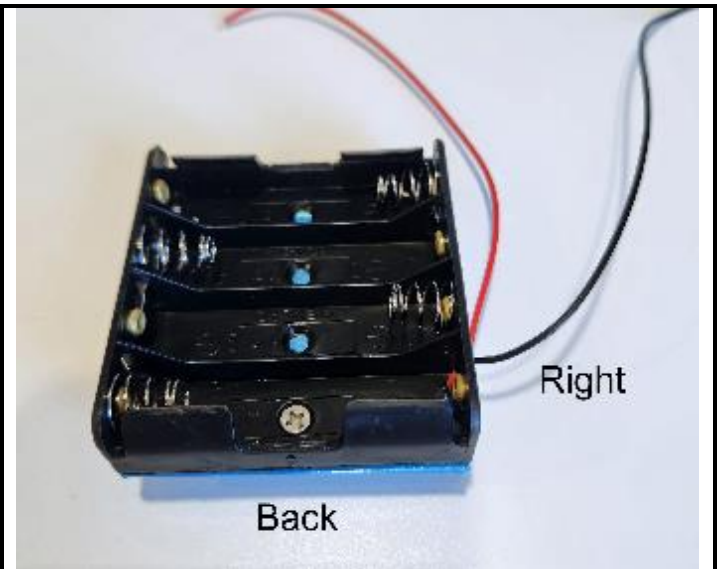


6. Insert and mount the ToF sensors. The rest of the assembly will be easier if the Maker Pi board is flipped over the and ToF sensors are inserted through the opening in the fender bar from behind, as shown. Insert the correct sensor into the correct side of the body. The left sensor is attached to Grove port 4 for VCC and GND.

Secure the sensors with a bolt at the top of each sensor and a nut inside the top hole on the fender bar. The bottom of the sensor does not need a bolt (the bottom holes are there to be used in case the top ones break out). Note that the black rectangles on the sensors are at the outside edges of the robot.

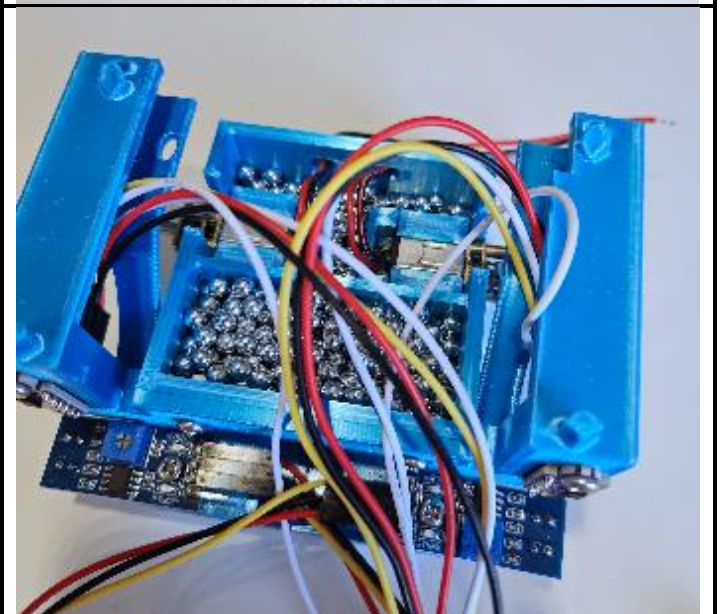


7. Mount the battery box to the main body lid using the countersunk bolt. Bolt from the inside of the battery box through the box and lid and secure underneath with a nut. The top of the bolt should not be above the top of the inside of the battery holder bottom so that the batteries will install fully. The battery wires should be on the right side of the assembly with the bolt in the rear hole in the box, as shown.



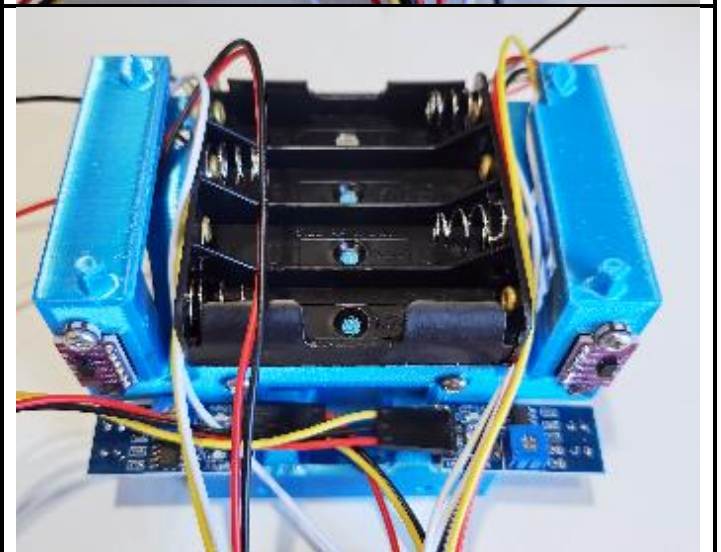
8. If the main body will be ballasted, fill one or both compartments with ballast. If the ballast is electronically conductive is important that the ballast cannot come into contact with the soldered tabs at the back of the motors. Here steel BBs are being used, but they are too large to come into contact with the motor tabs.

Round ballast can easily roll out of the ballast box and spill widely until the lid/battery box are added in the next step, so be careful in handling the robot at this point.

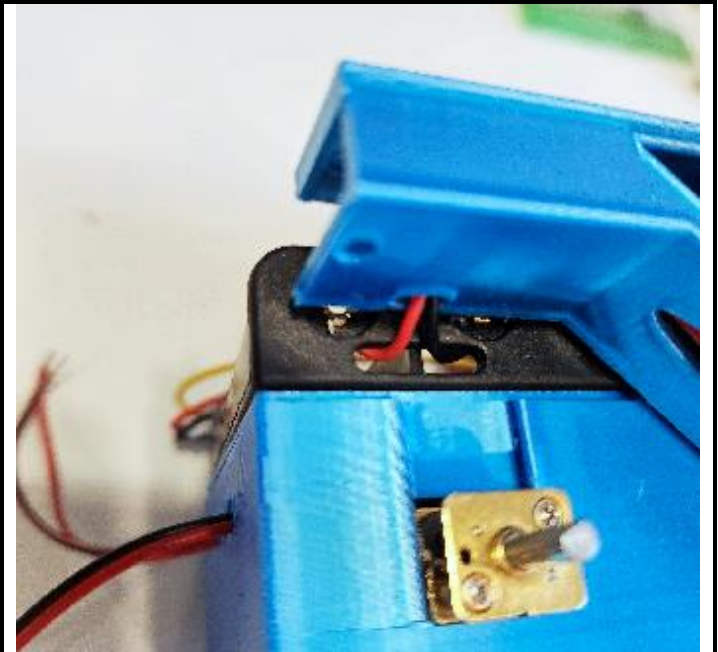


9. Add the lid/battery box assembly. The long tabs on the bottom of the lid insert into the openings over the motors. Start the insertion gently with all tabs on the lid assembly inside the walls of the main body and then press down until the lid is fully inserted against the top of the main body. It's ok if it is a bit loose as other parts to be added will keep it from spilling ballast of this size.

Tuck as much of the ToF wire from the Grove cables as possible into the fenders. It can be folded roughly in half and exit back to the Maker Pi board through open top slots in the front of the fender bar, as illustrated.

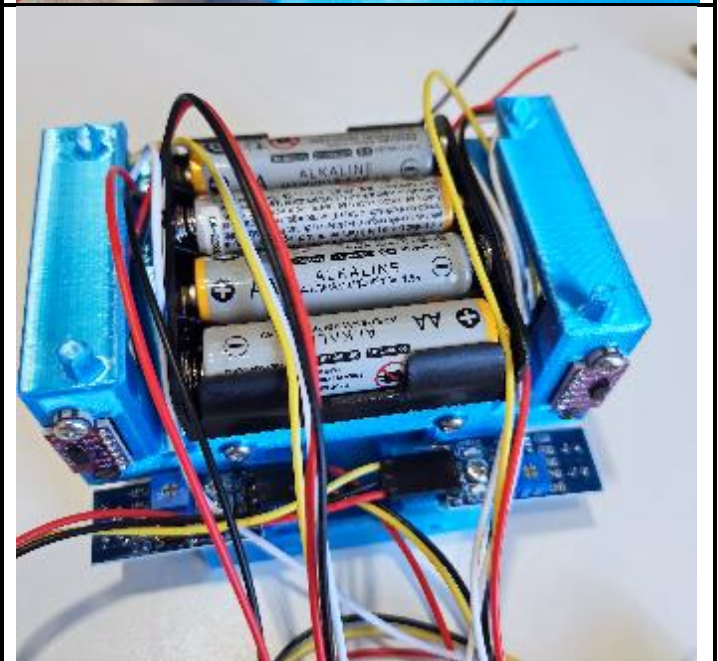


10. Thread the motor wires up through the small oval in the bottom layer of the right side of the fender, as shown. They should exit out through the two layers of the fender to the rear of the robot (not shown).



11. Install the batteries in the orientation shown on the battery box.

Be aware that the battery wires are now live (there is no on/off switch on the battery box) and the exposed ends can give a shocking lesson in how many watts 4 AA batteries can produce. Do not let the exposed ends of the battery wires contact each other or short against anything conductive. It's a good idea to put a small piece of tape over one of them until they are screwed down to their terminal on the Maker Pi board.

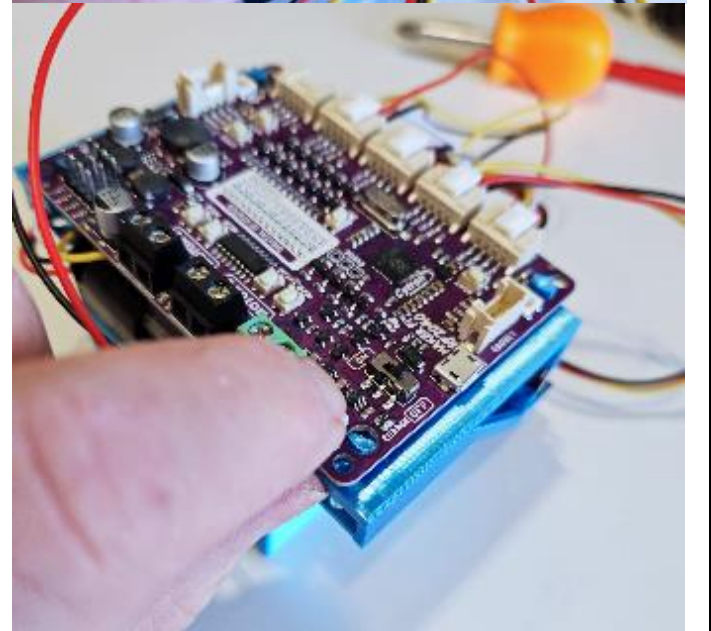
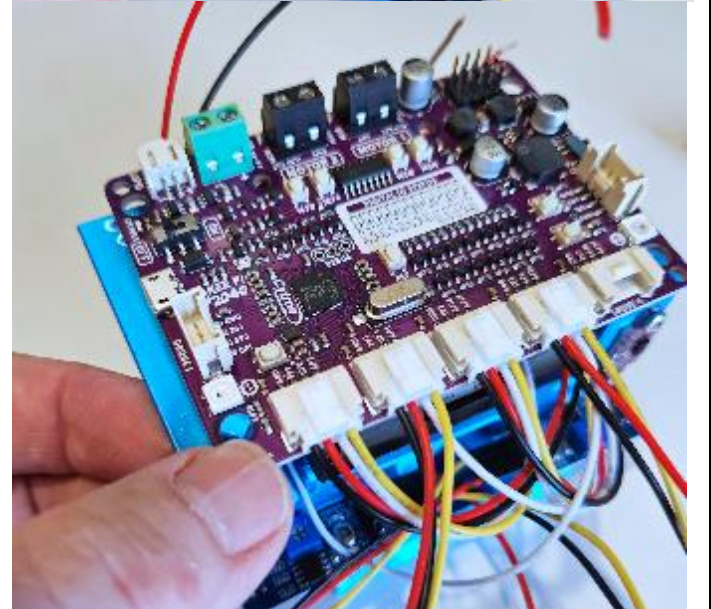
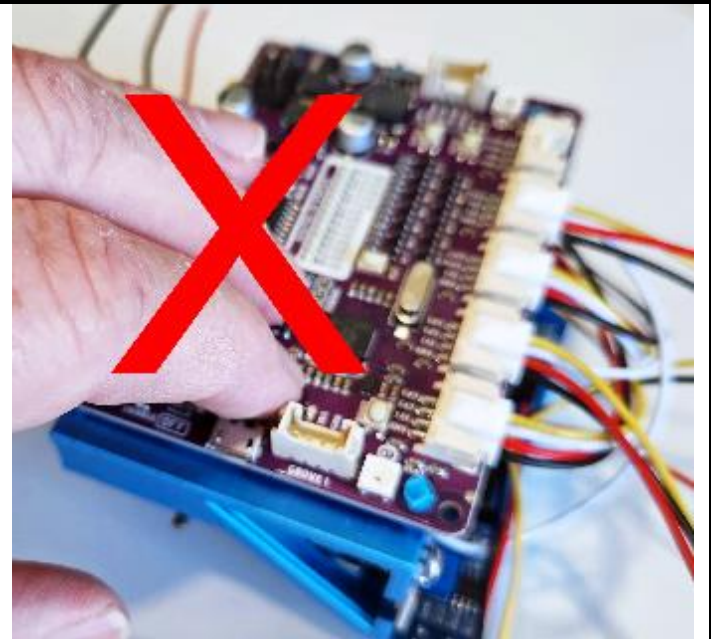


12. The Maker Pi board can be flipped right side up and snapped into place.

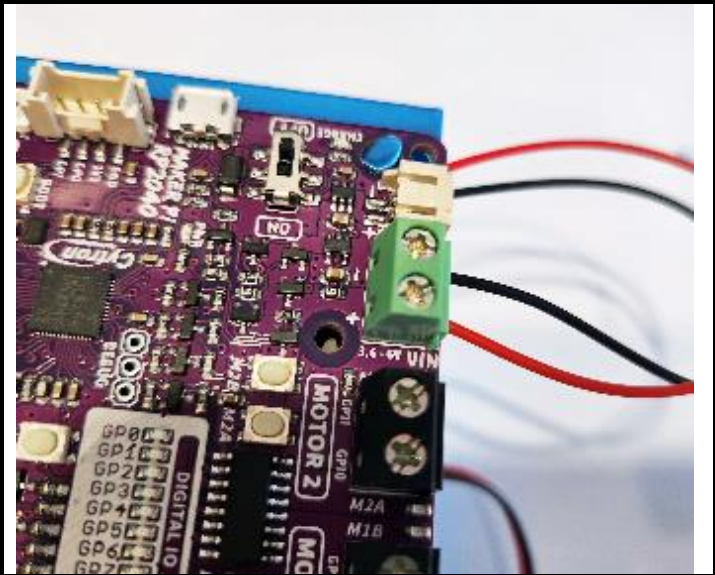
Do not attempt to snap it down by pressing down from above. This will permanently warp or possibly break the fender bar.

Instead, snap the front of the board into the posts at the front of the robot by squeezing the board and the top layer of the fender together on both sides. It may be difficult the first time it is done. Then snap the board to the rear posts on both sides by squeezing the board and the top layer of the fender together at the back, as shown.

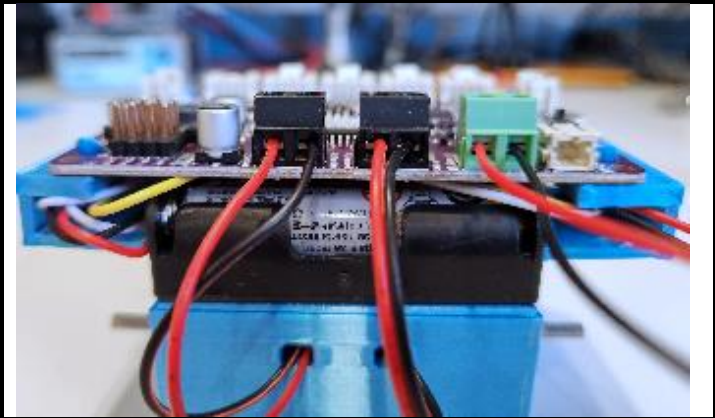
The bolt holes at the back of the board and fender are not used unless the posts have worn enough over time that bolts are needed to keep the board in place.



13. Screw the exposed ends of the battery wires from the battery holder to the green terminal block on the Maker Pi board. The screws open to provide a clamp to secure the wires when closed. Make sure the black wire is secured to the clamp marked “-” on the front of the block and the red wire to the clamps marked “+” to have the correct polarity. The exposed wire but not the insulated part should be fully enclosed by the terminal block clamps.



14. Screw the exposed ends of the motor wires to the black “Motor 1” terminal (for the left motor) and the “Motor 2” terminal (for the right motor) on the battery board. At this point it doesn’t matter which color wire goes to which clamp on the first terminal as motors do not have polarity and these wires can easily be reversed if you find your robot goes backwards when you want it to go forward. However, be consistent on the color arrangement between the blocks, as shown.



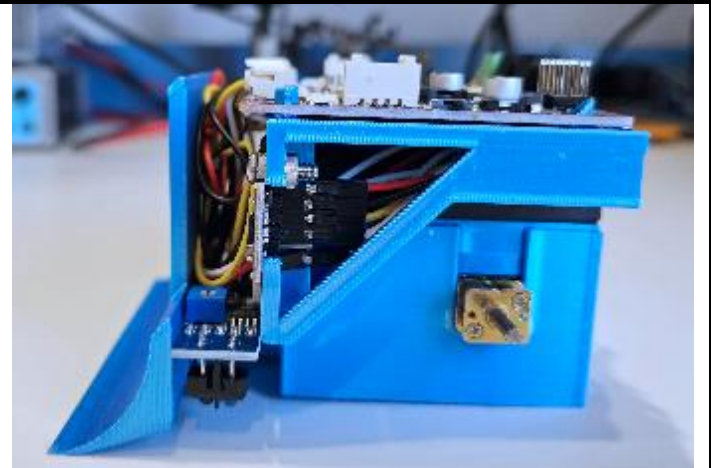
15. Tuck in the wiring by pushing the battery wires into the right fender channel and pushing the motor wires into the main body. The extra length will be needed later to change batteries without unscrewing the wires.





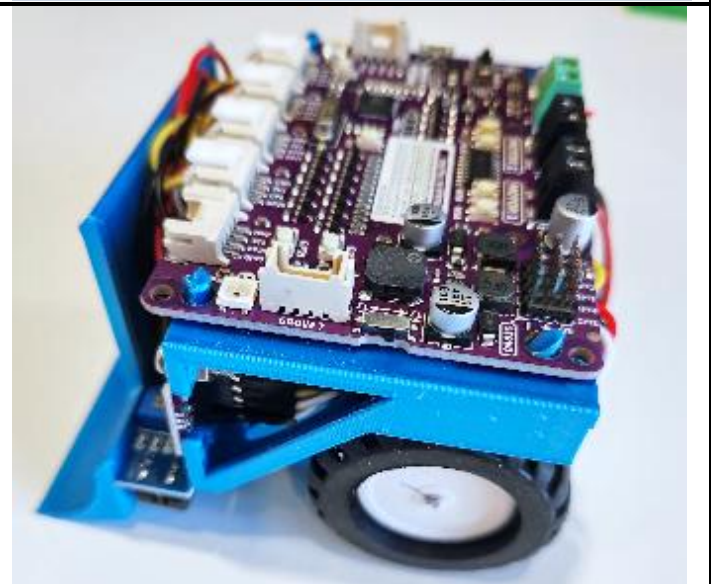
16. Attach the front blade to its mount on the main body by inserting two bolts from the front for the blade and securing them with nuts underneath. The front of the blade will be slightly lower than the main body. The robot will sit level once the wheels are attached.

Fold and tuck the remaining lengths of sensor wire behind the blade as you secure it. Do not let wire get caught between the blade and where it mounts to the main body. Everything will be a snug fit. Keep wiring clear of the ToF sensors and the blue adjustment blocks on the edge detection sensors.



17. Mount the wheels and tires with the flatter side of the wheel to the outside. The motor shafts have a D shape and this should be aligned the D shape on the wheel before they are pressed on. They should be against the main body without being so tight against it that they cause friction.

Assembly is complete. Now is a good time to make sure your robot will fit with the regulation width of 10 cm and length of 10 cm (loosely fitted wheels and wires may cause it to be oversized).



18. Assembly is complete. If software has not been downloaded it can be done now. The Maker Pi board has to be turned on to download software or run the robot.

When it is time to change the batteries you can do so without tools. Pull the extra wire from batteries and the motors out from storage. Gently unsnap the Maker Pi board and tilt it forward to give access to the battery box.

Once the batteries are changed remember to snap the Maker Pi back down by squeezing it to the top of the fenders, not by pushing down on the board. Snug the wires back up tight to the robot.

