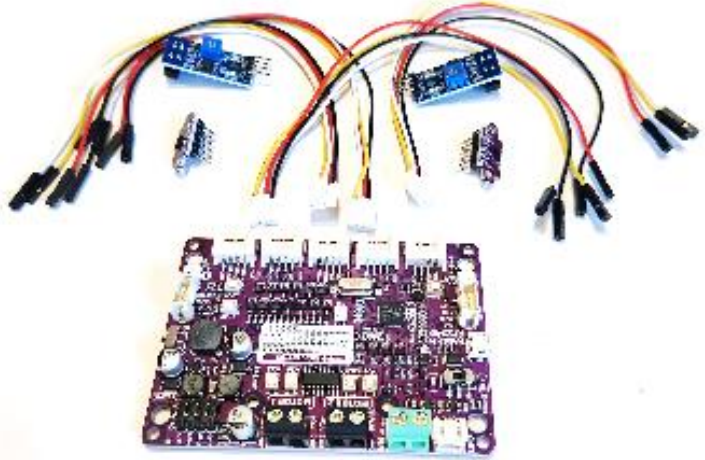Assembly instructions for BB1 mini sumo bot. Please consult the parts preparation information before assembly.

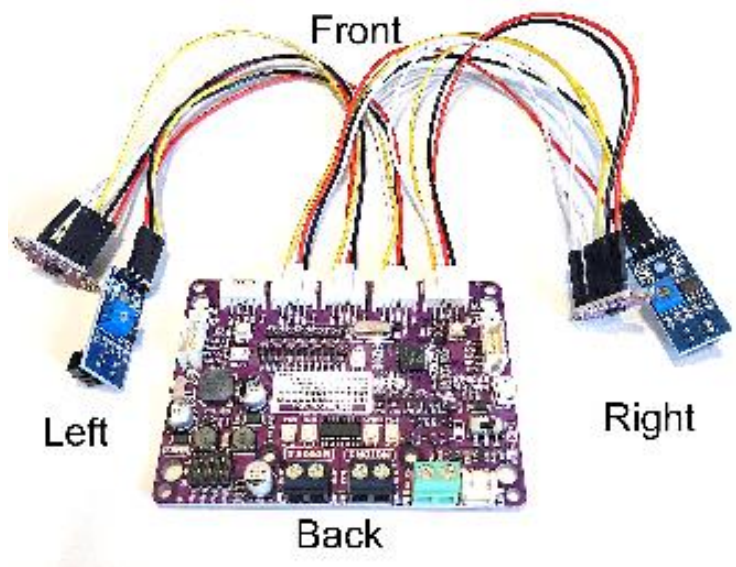|	
1. Lay out the electronics for the robot. This includes the Maker Pi RP2040 board (qty. 1) with grove connecter cables (qty. 4), ToF (VL53L0X Time of Flight) sensors (qty. 2), and edge detection (TCRT5000 infrared reflective) sensors (qty. 2).	
2. Connect the electronics according to the following 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 "le ft," "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	

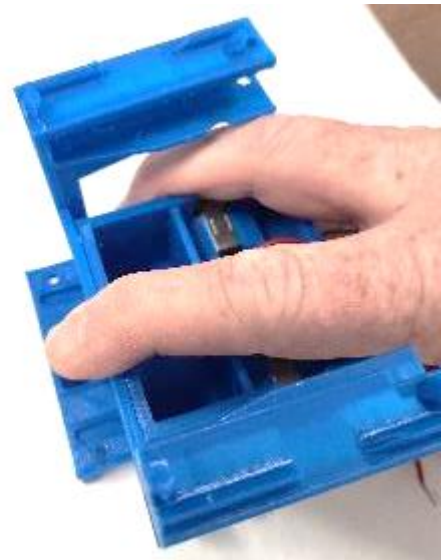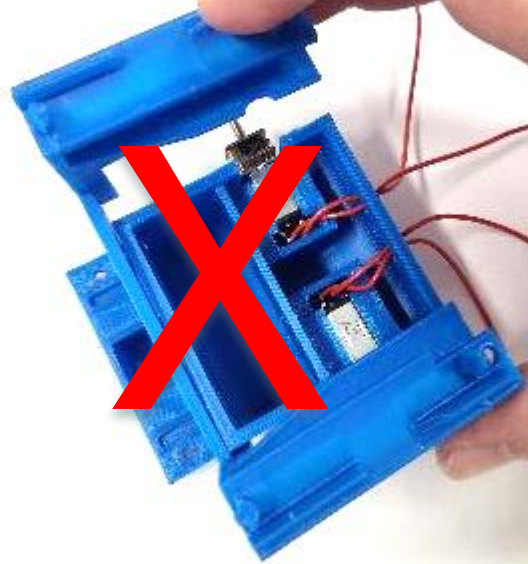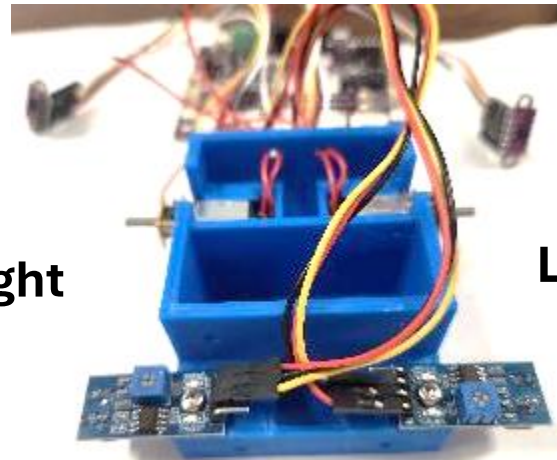|	
GP26 -> Right edge detection DO Set the electronics assembly aside while keeping track of the left/right orientation of parts. It's a good idea to mark L or R on the sensors with a sharpie.	
3. Insert the motors into the main body. It doesn't matter which motor goes into which side. The motors are 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.	**Front**
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.	 **Front**

5. If the front ballast box is being used, fill the box and secure the ballast. BBs will get loose and roll all over. These should be mixed with some sort of glue and poured in if used (not illustrated). Allow the glue to set before proceeding.

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.
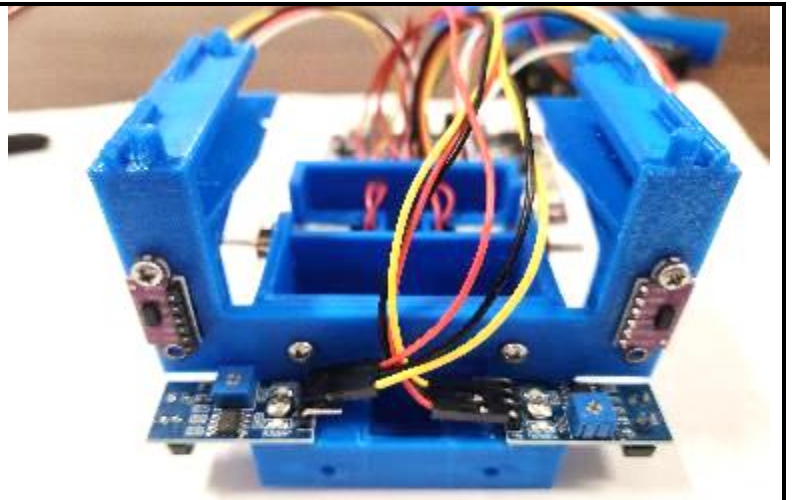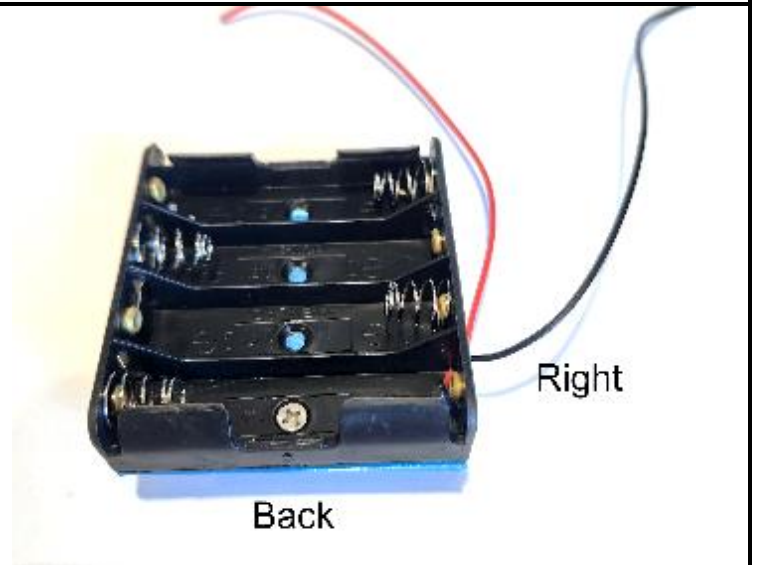

Right

Left

Front

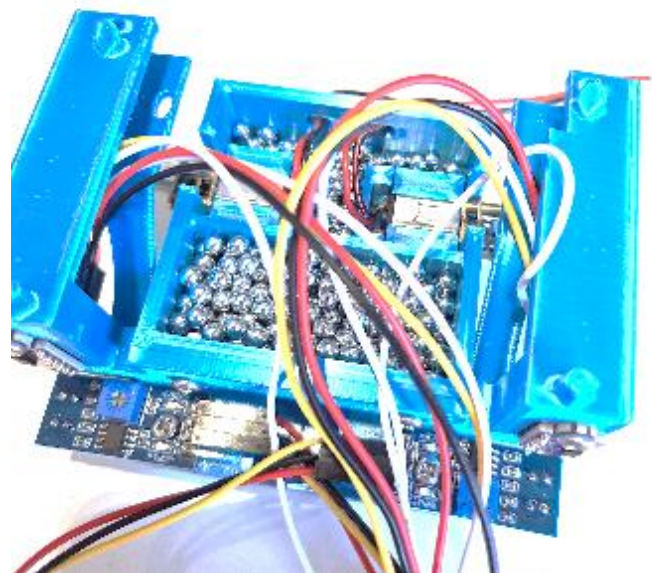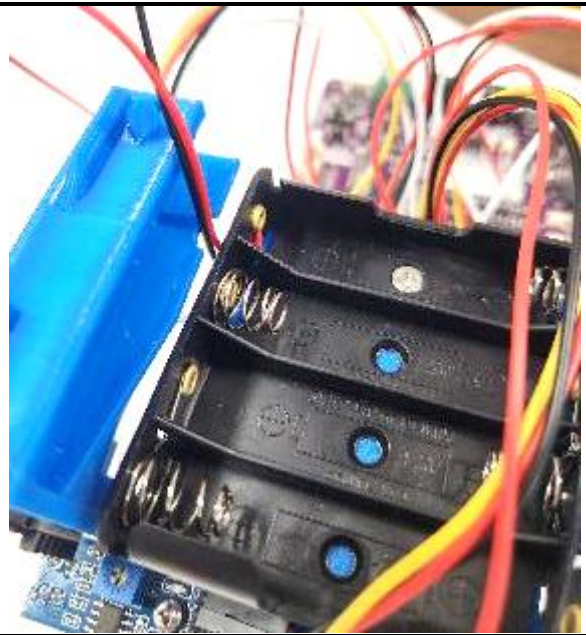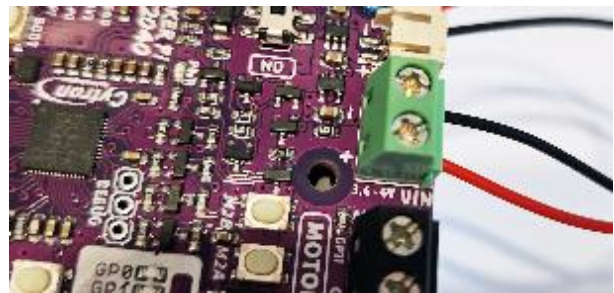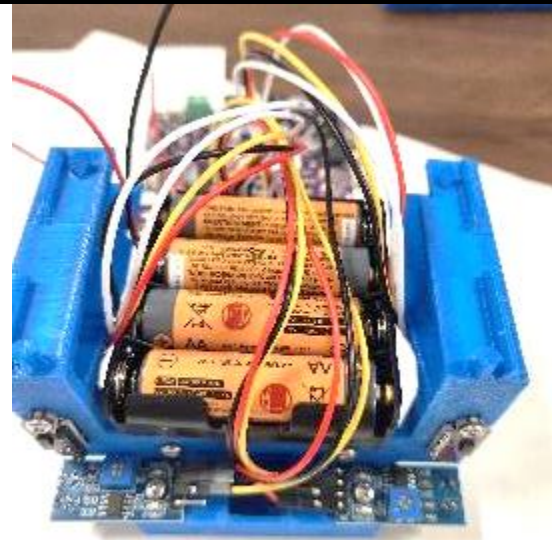|	
6. Insert and mount the ToF sensors. Insert the correct sensor into the correct side of the body. The left sensor is attached to Grove port 4 for VCC and GND. Secure the sensors with a bolt at the top of each sensor and a nut inside the top hole on the fender bar. The bottom of the sensor does not 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.	 **Front**
7. Mount the battery box to the flat side of the 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.	 Right Back
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 (on an older chassis design), 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 secured with glue and the glue has set. It's important to weigh all of your robot's components together before the glue has set to make sure your robot will not exceed 500 grams.	

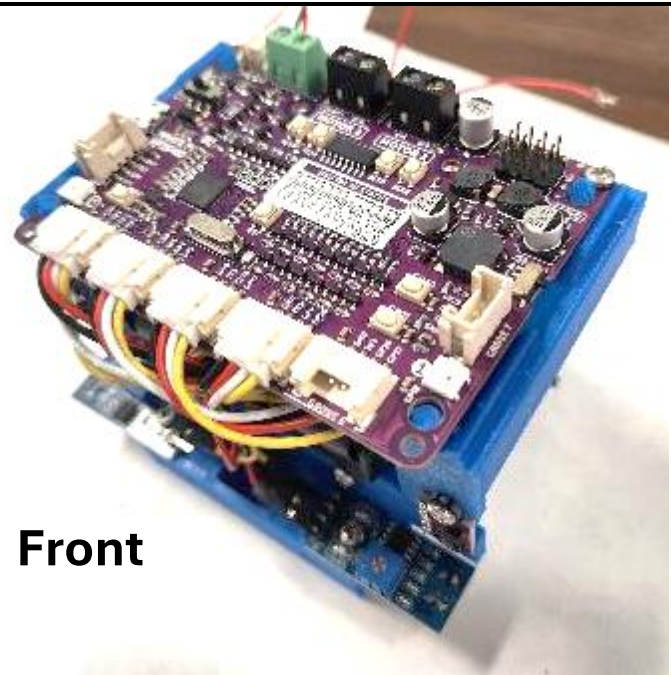|	
9. Add the lid/battery box assembly to the main body. It should snap into place on all four sides. There is a notch in the fender bar that will allow the battery wires to come up into it.	
10. Install the batteries in the orientation shown on the battery box. Be aware that the battery wires are now 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 screw them down to the green terminal block on the Maker Pi board right away. The screws on the block open to provide a clamp to secure the wires when closed. Make sure the black battery wire is secured to the clamp marked "-" on the front of the block and the red wire to the clamp marked "+" to have the correct polarity. The exposed wire (but not the insulated part) should be fully enclosed by the terminal block clamps.	

11. The extra wiring can be rolled into loops and placed between the top of the battery holder and the top of the fender bar. Loose wire should not be left where the wheels will go.

The Maker Pi board can be snapped into place over the posts in the fender bar. The white grove connectors go at the front.
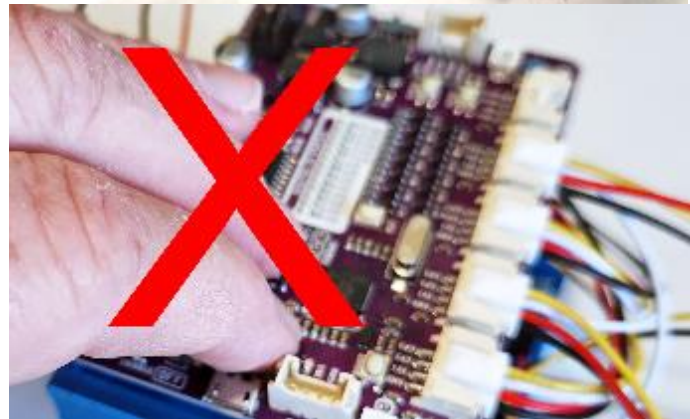
Do not attempt to snap the Pi board down by pressing down from above. This will permanently warp or possibly break the fender bar.

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.

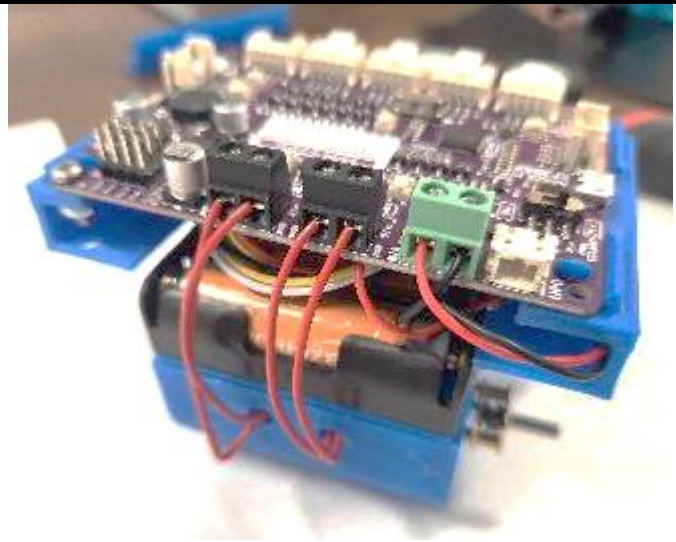The board can be bolted down to the fender bar using the holes at the back.

Front

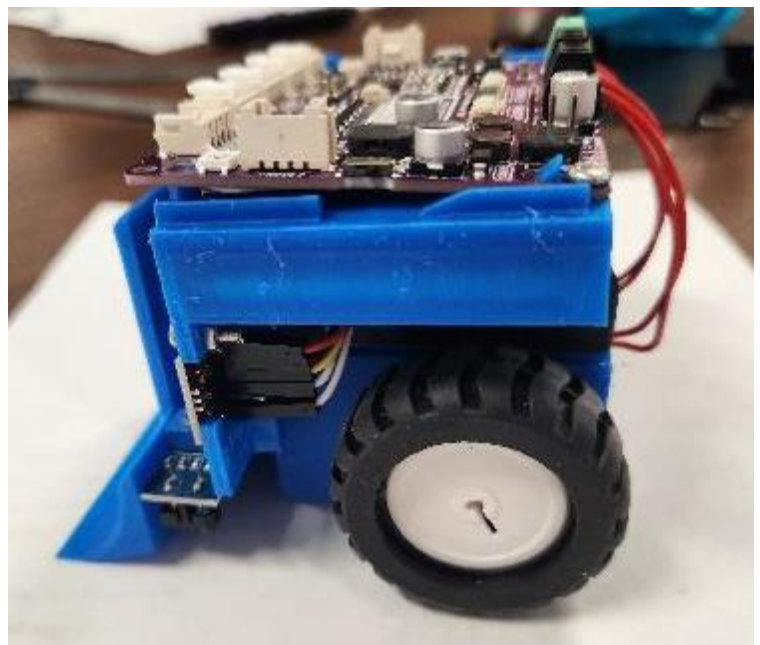|	
12. Screw the exposed ends of the motor wires to the black "Motor 1" terminal (for the left motor) and the "Motor 2" terminal (for the right motor) on the battery board. At this point it doesn't matter which wire goes to which clamp on the terminal as motors do not have polarity and these wires can easily be reversed if you find your robot goes backwards when you want it to go forward. 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.	
13. 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.	
14. 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. Note how the wires from the ToF sensors are pulled up into the fender bar so they don't rub on the wheels. 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).	

15. If software has not been downloaded it can be done now. Connect your robot to a computer using the USB cable. Using Thonny, Mu or other Python editor download 5 files to your robot from our repository: Adafruit_vl5310x.mpy, base_bot.py, code.py, settings.py, and original_code.py.

The Maker Pi board has to be turned on to download software or run the robot. The power switch on the Maker Pi board is marked with ON and OFF settings.

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 and spread them apart enough to clear the battery box. Gently lift the battery off the main body and slide it out of the back of the robot to replace the batteries.