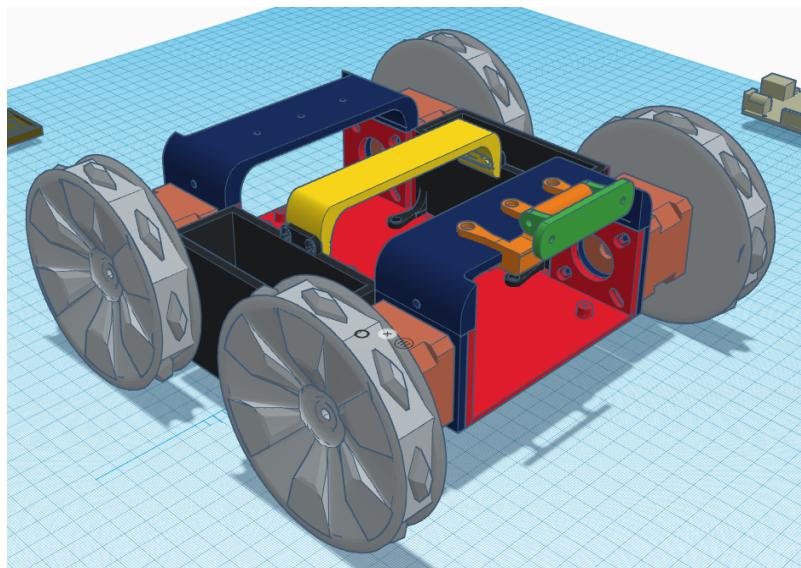
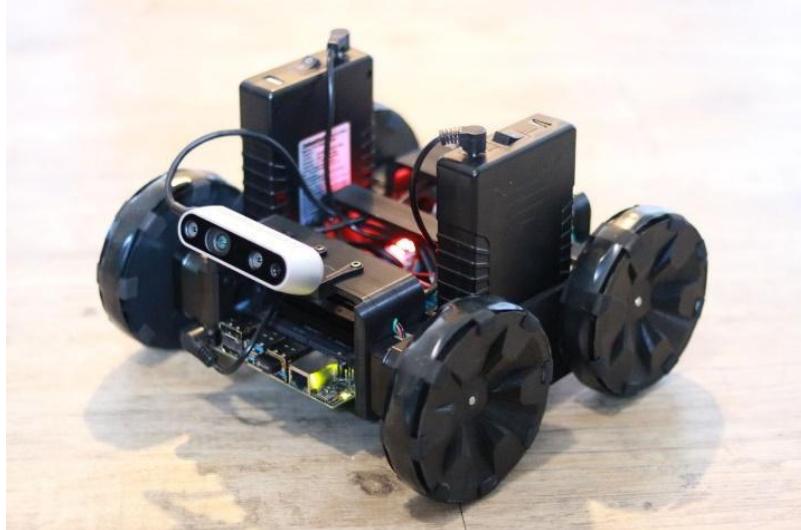


RE-RASSOR Physical Rover Assembly Guide

Francis Fermo, Alex Hillegass, Michaela Pinter, Conner Weik, Brandon Clark



3D Design by Francis Fermo

Getting Started

Before attempting to assemble the rover, we strongly recommend configuring the NVIDIA Jetson Nano to properly run Ubuntu 18.04 and the EZ-RASSOR simulation. To troubleshoot the rover during testing, we would remote into the NVIDIA Jetson Nano over a wireless network via an SSH protocol. We also had an HDMI cable, video monitor, and USB mouse and keyboard readily available for more in-depth troubleshooting of the Jetson Nano.

After configuration of the NVIDIA Jetson Nano is complete, we also recommend [configuring](#) and [calibrating](#) the Intel RealSense D435i camera to have the appropriate settings and libraries necessary for use with the EZ-RASSOR software.

Please note that the assembly configuration used in this guide has been specifically tailored for the hardware and 3D parts used for RE-RASSOR. Any replacements or substitutions made for the specified hardware and 3D parts will likely introduce conflicts with fitment or functionality.

Tools

- Phillips-head (crosshead) and Flathead Screwdriver
- 3mm Allen Key
- Needle-nose Pliers
- Wire Strippers
- Soldering Iron

Hardware

- NVIDIA Jetson Nano
 - <https://www.amazon.com/dp/B084DSDDL/>
- Nema 17 Bipolar 1.8deg 26Ncm Stepper Motors (x4)
 - <https://www.omc-stepperonline.com/nema-17-bipolar-1-8deg-26ncm-36-8oz-in-0-4a-12v-42x42x34mm-4-wires.html>
- Arduino Mega 2560 R3 (x1)
 - <https://www.amazon.com/dp/B0046AMGW0>
- USB 2.0 A Male (Male) to B (Male) Cable
 - <https://www.amazon.com/gp/product/B009GUVZOK/>
- Adafruit MotorShield V2 (x2)
 - <https://www.amazon.com/Adafruit-Motor-Stepper-Shield-Arduino/dp/B00PUTH3B0/>
- TalentCell Lithium-Ion Battery (x2)
 - <https://www.amazon.com/gp/product/B00ME3ZH7C/>
- Intel RealSense D435i Camera (x1)
 - <https://store.intelrealsense.com/buy-intel-realsense-depth-camera-d435i.html>
- 3ft USB-C Cable for RealSense
 - <https://www.amazon.com/gp/product/B01A6F3WHG/>
 - An [issue](#) during implementation caused us to replace the camera's included cable.
- LM2596S Buck Converter (x1)
 - <https://www.amazon.com/gp/product/B081N6WWJS/>
- DC Plug Connector Kit
 - <https://www.amazon.com/gp/product/B07CWQPPTW/>
- TP-Link USB WiFi Adapter
 - <https://www.amazon.com/gp/product/B008IFXQFU/>
- Wiring Kit
 - <https://www.amazon.com/gp/product/B081H2JQRV/>
- M3 Hex Screws (varying sizes)
 - <https://www.amazon.com/gp/product/B076LMXW17/>
 - <https://www.amazon.com/gp/product/B01I74TTWU/>

- M2.5 x 6mm (x12)
 - <https://www.amazon.com/uxcell-Phillips-Fasteners-Laptop-Switch/dp/B08J3ZC9W4/>
- Stacking Headers for MotorShield
 - <https://www.amazon.com/ADAFRUIT-INDUSTRIES-85-STACKING-COMPATIBLE/dp/B00LB76EVU/>

Printed Parts



Wheels.stl (x4)



Chassis_Base.stl (x1)



Wheel_Support.stl (x2)



Battery_Holder.stl (x2)



Battery_Support.stl (x1)



Camera_Mount.stl (x1)



Swivel_Mount.stl (x1)

Optional Accessories

- Shock absorption tape (for wheels or vibration dampening)
 - <https://www.amazon.com/gp/product/B07GBMT736/>
- Electrical tape (for wheels or wiring)
 - <https://www.amazon.com/gp/product/B0002FTGEE/>
- Zip ties (cable management)
 - <https://www.amazon.com/dp/B07VRSQ6YL/>

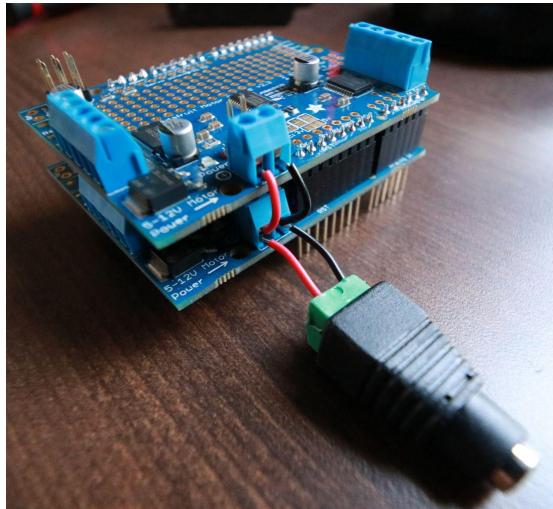
Pre-Assembly

1. Solder stacking headers onto Adafruit MotorShield V2. Info on stacking MotorShields can be found here:

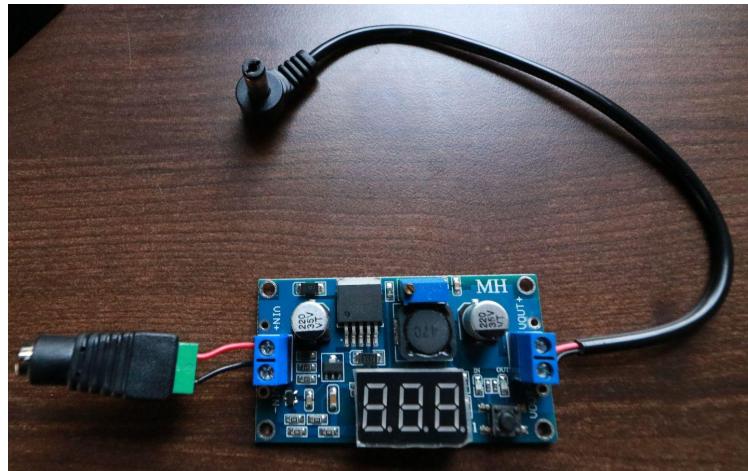
<https://learn.adafruit.com/adafruit-motor-shield-v2-for-arduino/stacking-shields>



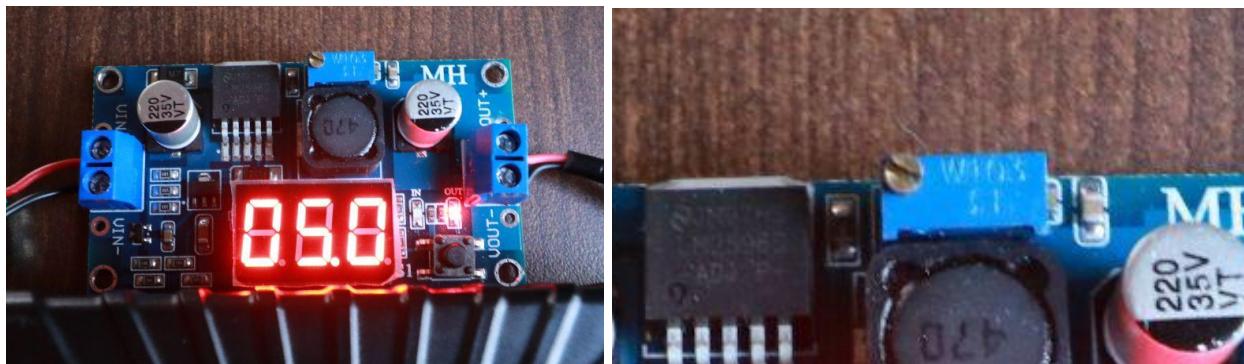
2. Insert jumper wires and DC plug into MotorShields as shown.
 - a. Do NOT use jumper pins that came with MotorShields.



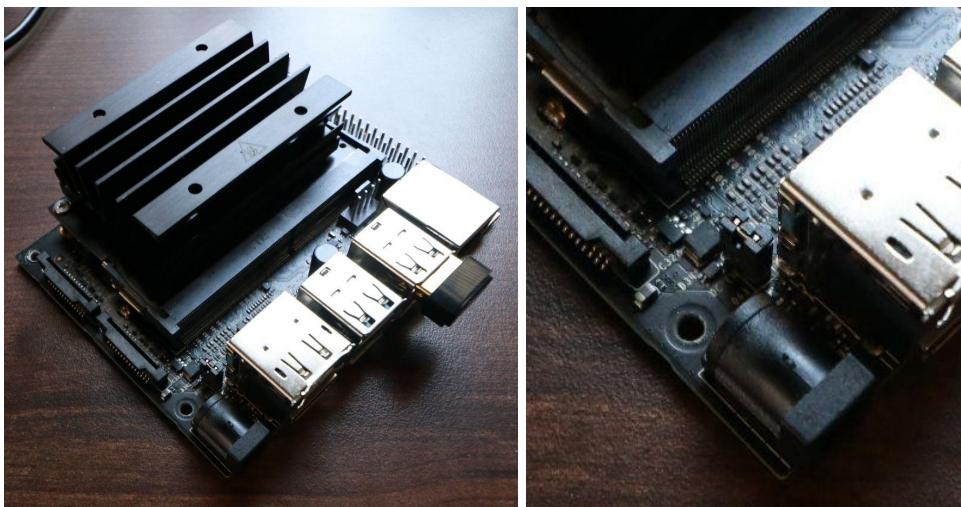
3. Insert DC plugs into LM2596S buck convert as shown.



4. Plug battery into Buck Converter. Using a flathead screwdriver, turn the screw clockwise (increase) or counter-clockwise (decrease) to adjust voltage. Set voltage to 5V.
 - a. Leave the output of the buck converter disconnected while doing this step.



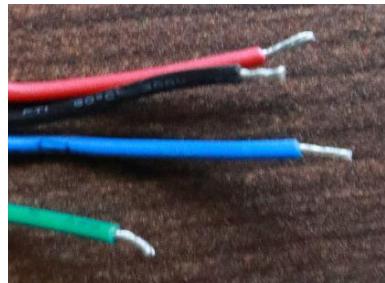
5. Insert jumper pin as shown on NVIDIA Jetson Nano.



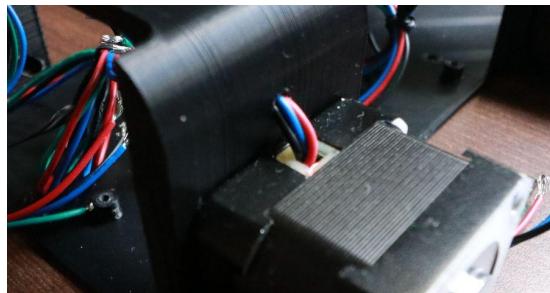
6. Attach Swivel_Mount.stl to Intel RealSense Camera using M3x5mm screws (x2).



7. Cut and strip stepper motor wires.



8. Feed wires from stepper motors through side holes in Wheel_Brace.stl.



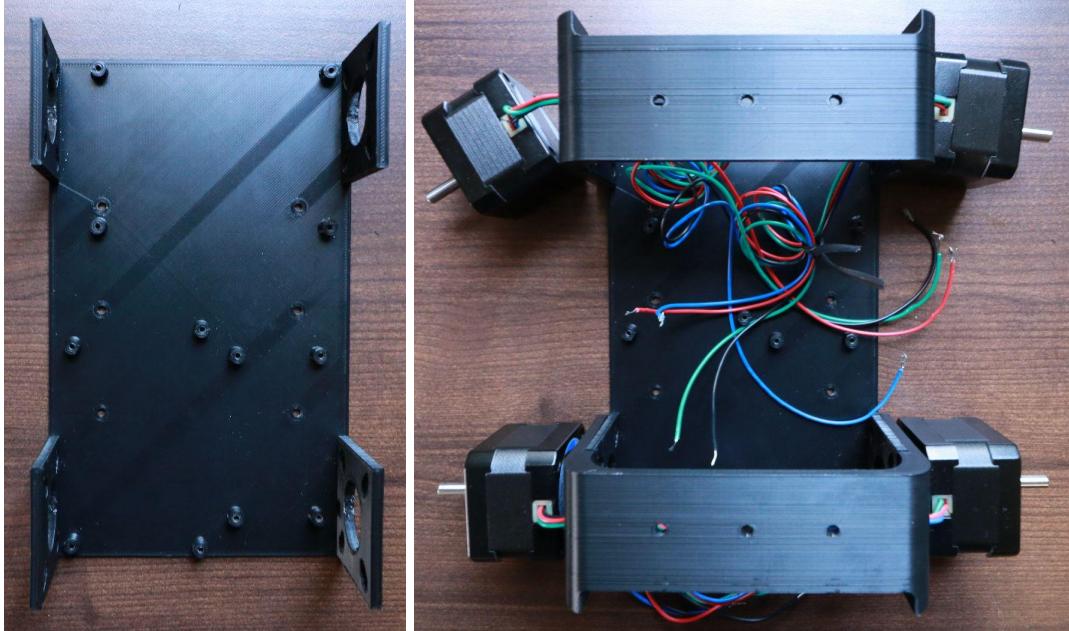
9. For Wheels.stl, we recommend using a combination of foam and electrical tape to add tread and friction between wheel and ground surface. Performance of wheels is dependent on ground surface type.



Assembly

For our implementation, we have designated a front and back of the rover. Also make note of the orientation of the curved indent in Wheel_Brace.stl in relation to the chassis.

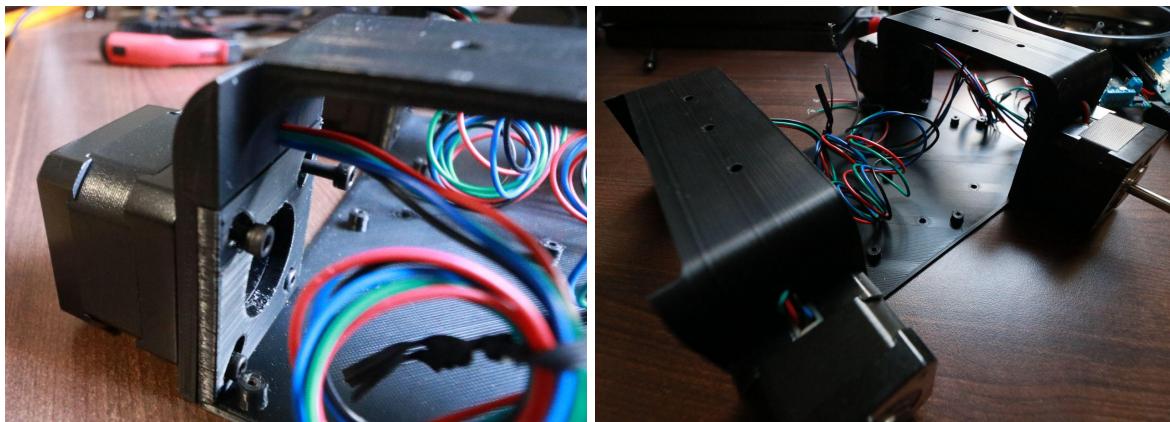
FRONT



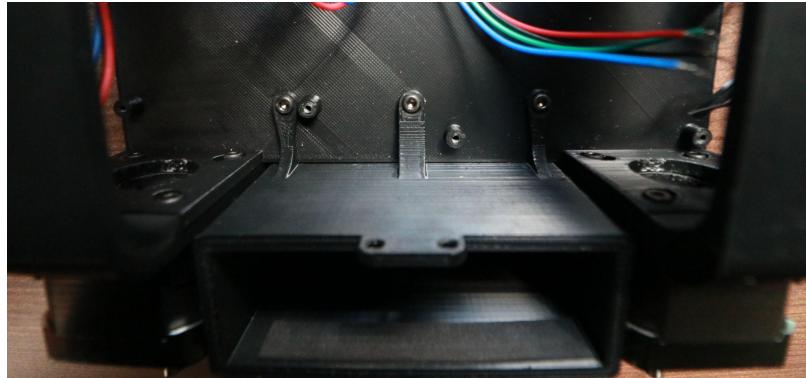
BACK

We recommended marking each motor to identify which wheel is which (i.e. front left, front right, etc.). This makes it easier during the flashing process of the Arduino Mega so that the firmware code will not need to be edited.

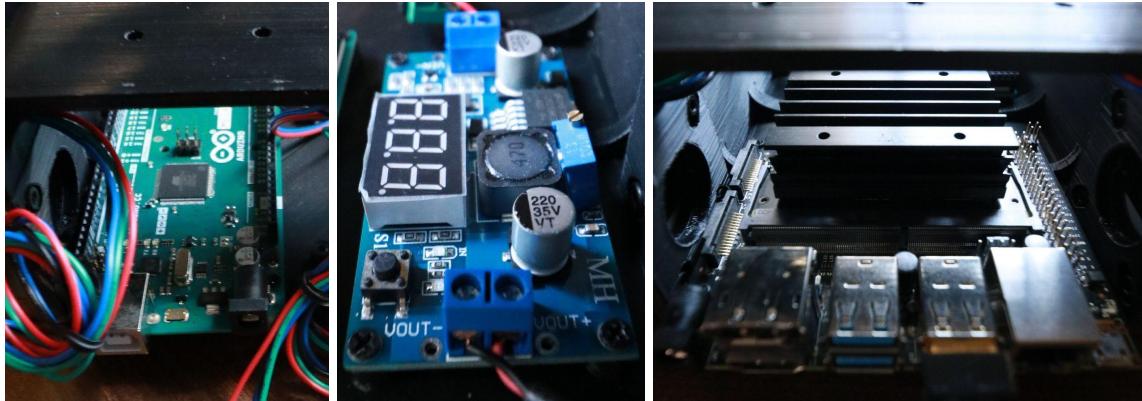
1. Seat Wheel_Brace.stl on top of chassis as shown above
2. Pass the M3 x 35mm screws from the inside of the chassis, through Wheel_Brace.stl, and thread into the stepper motors. Do this for all four motors.



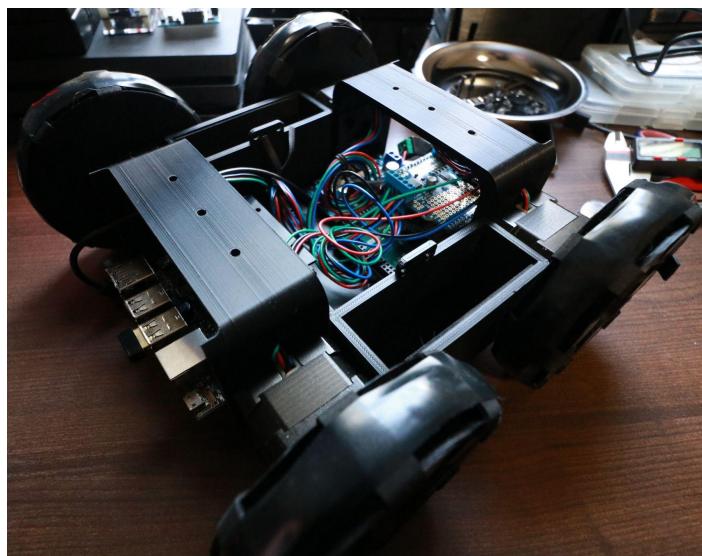
3. Attach both Battery_Support.stl to the chassis using M3 x 10mm screws and nuts (x6 each).



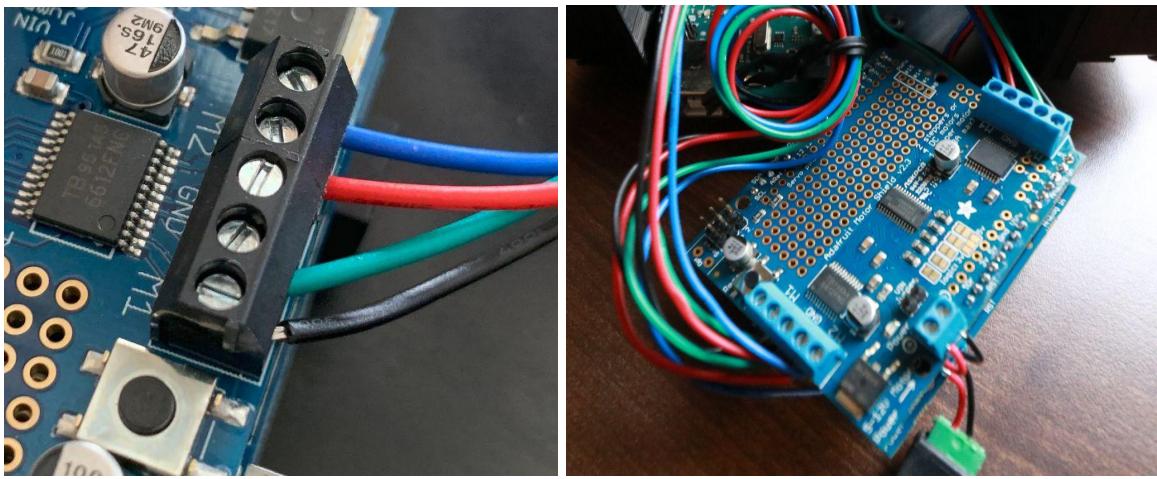
4. Using M2.5 x 6mm screws (x16), mount Arduino Mega2560, LM2596S Buck Converter, and NVIDIA Jetson Nano to standoffs in chassis.
 - a. Do NOT overtighten as M2.5 screws self-thread into chassis standoffs.



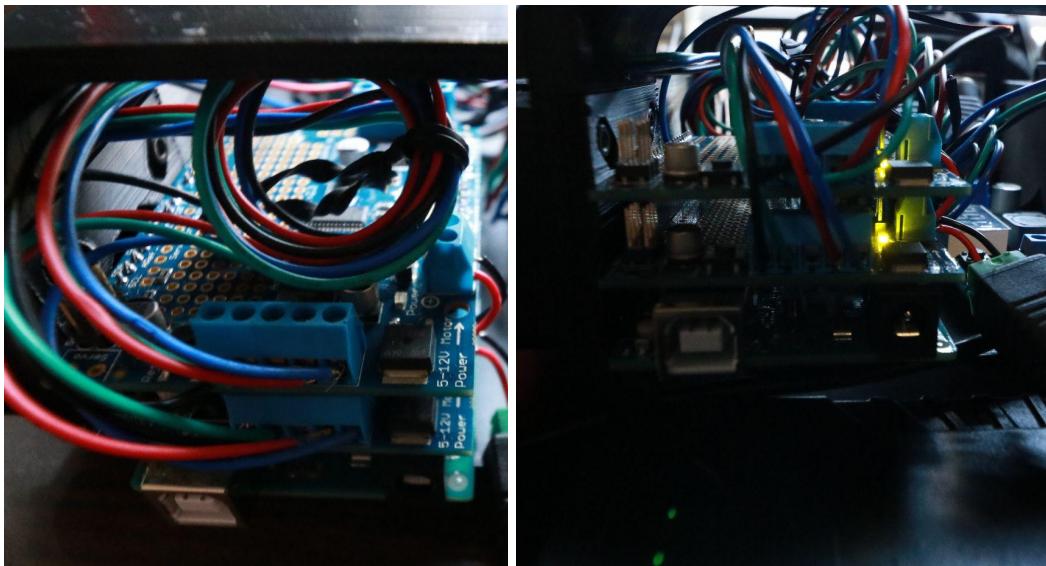
5. Slide Wheels.stl onto stepper motor shafts.



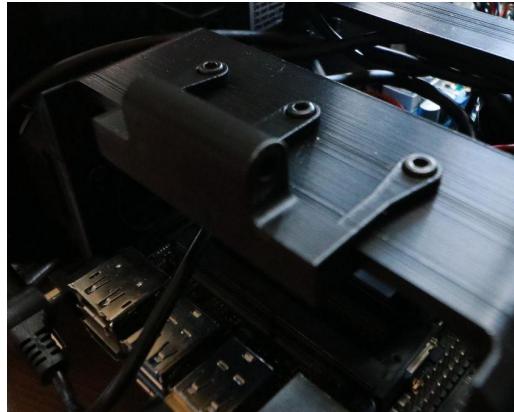
6. Using a flathead screwdriver, unstack the Adafruit MotorShields and connect stepper motor wire leads.
 - a. For this step, the Adafruit MotorShields with address 0x60 and 0x61 will be referenced as the top and bottom shield respectively. Please reference Adafruit's [stacking shields guide](#) for more info.
 - i. Front left wheel -> M1-M2 of top shield.
 - ii. Front right wheel -> M3-M4 of top shield.
 - iii. Back left wheel -> M1-M2 of bottom shield.
 - iv. Back right wheel -> M3-M4 of bottom shield.



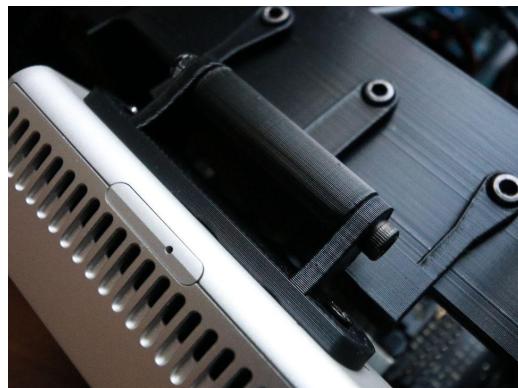
7. Stack Adafruit MotorShields and mount on top of Arduino Mega 2560 R3.
 - a. Test that wiring is correct for power supply by connecting battery to DC plug wired in pre-assembly. Note that the Arduino Mega 2560 is not powered with this configuration.



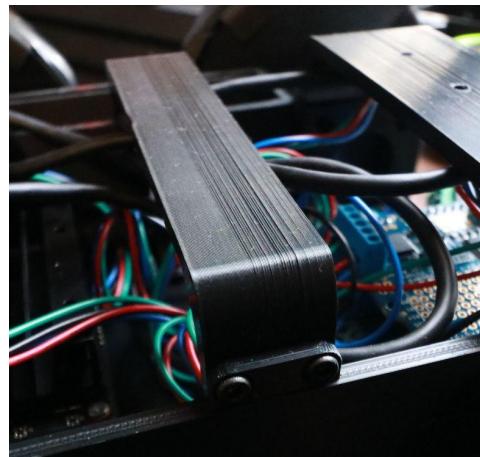
8. Using M3 x 12mm screws and M3 nuts (x3 each), mount Camera_Mount.stl onto FRONT Wheel_Support.stl.



9. Using M3 x 40mm screw and M3 nut (x1 each), mount the RealSense camera with pre-assembled Swivel_Mount onto Camera_Mount.stl.



10. Using M3 x 10mm screws and M3 nuts (x4 each), mount Battery_Support.stl onto each Battery_Holder.stl



11. Using a male to male DC cable, connect the output jack of the LM2596S buck converter directly to the DC jack of the NVIDIA Jetson Nano.

- a. Make sure to follow pre-assembly instructions for the LM2596S buck converter on page 6.



12. Slide both TalentCell batteries into each Battery_Holder.stl and start connecting the components together.

- a. Connect one battery to the LM2596S buck converter. Connect the other battery to the DC jack installed on Adafruit MotorShield.
- b. Connect TP-Link USB WiFi plug into one of the available USB jacks of the NVIDIA Jetson Nano.
- c. Connect the USB A to B cable from the Arduino Mega 2560 to one of the available USB jacks of the NVIDIA Jetson Nano.

RE-RASSOR has been assembled!

Check out the [EZ-RASSOR Github](#) repository for usage instructions.

