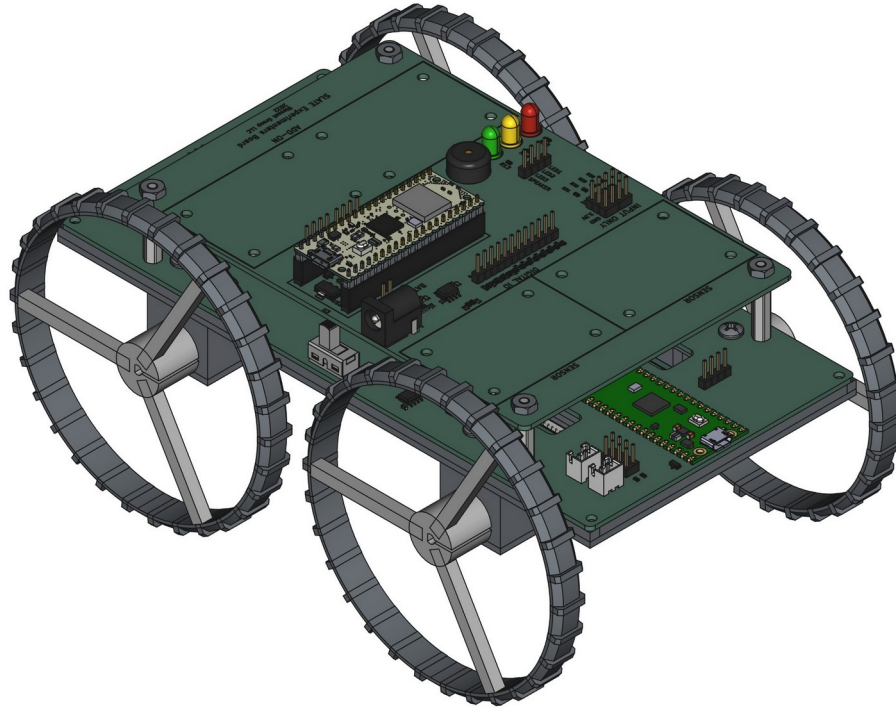


# Robot Assembly

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- The robot kit includes the following:
  - UGV Board
  - Four geared motors with encoders
  - Li-ion battery and charger
  - Zip ties
  - Pink bag of hardware to assemble the robot
- Clear bag with M1.6x4 screws
- 20 jumper wires
- 4 Motor cables
- 2 Power cables
- Camera module

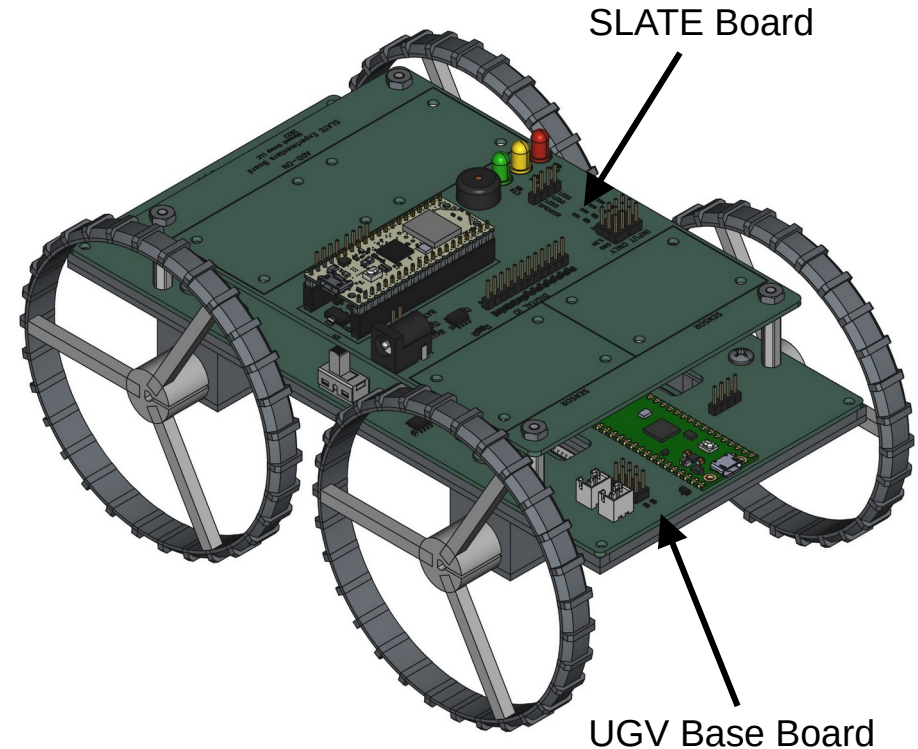
# Bag Contents

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- Pink Bag
  - 4x – 1" standoffs
  - 8x – 1/2" #4 sheet metal screws
  - 8x – 3/8" 4-40 screws
  - 12x – 4-40 nuts
- Clear Bag
  - 8x -M1.6x4 screws

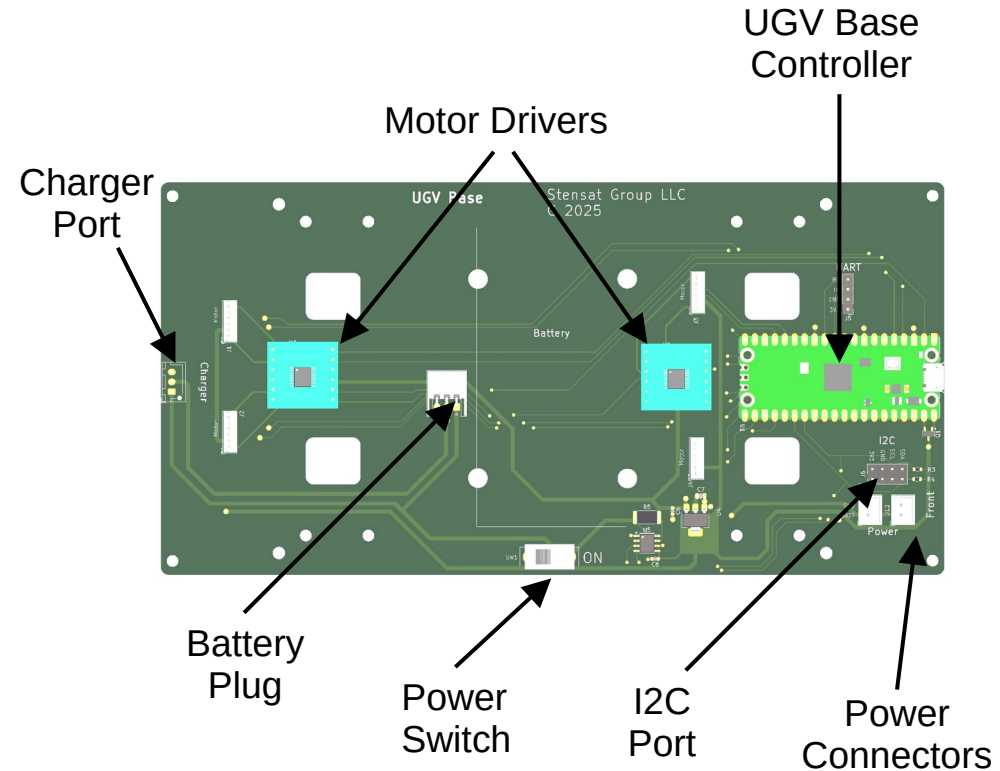
# Parts of Robot

- The robot is a 4-wheel drive type robot.
- Each drive wheel has a wheel encoder on the motor shaft. The wheel encoders allow for measuring wheel velocity and calculating travel distances.
- Four standoffs are included to allow mounting of the SLATE electronics board.
- Use the pink bag of hardware for assembly.



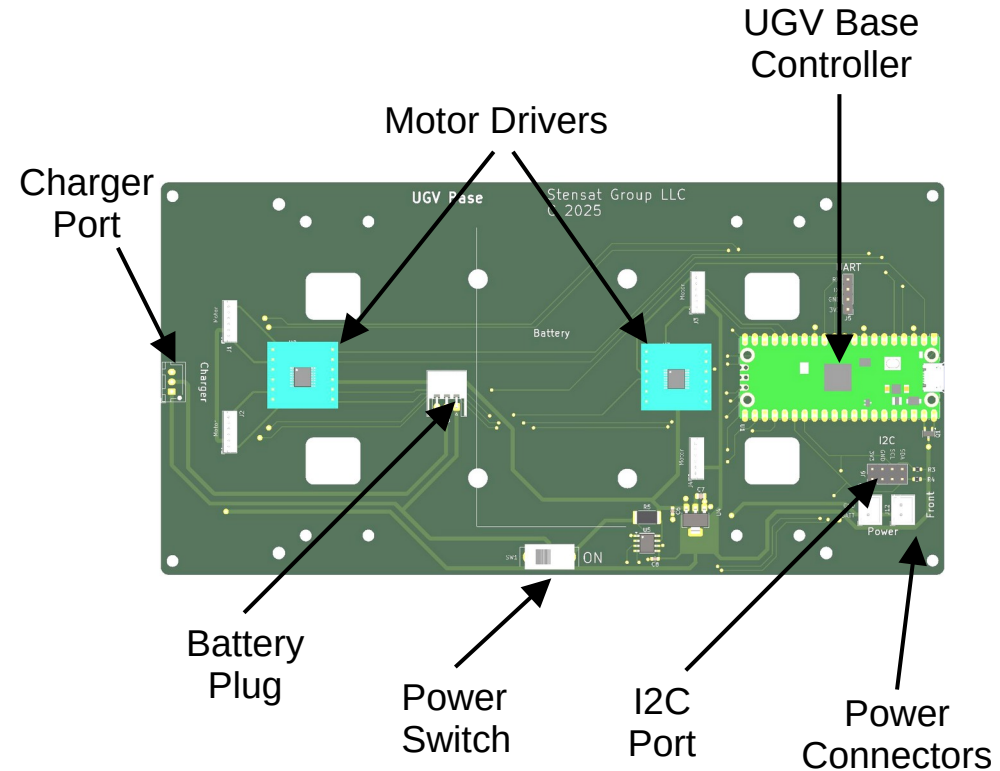
# UGV Base

- The UGV Base Controller provides an I2C interface to control the speed of four motors and also provide wheel encoder values that can be used for measuring distance travel and controlling the speed of the wheels.
- There is an I2C port to connect to the SLATE for controlling the UGV Base Controller.
- There are two power connectors. They provide battery power that will be used to power the SLATE board. A second connector is available to provide battery power to another device.



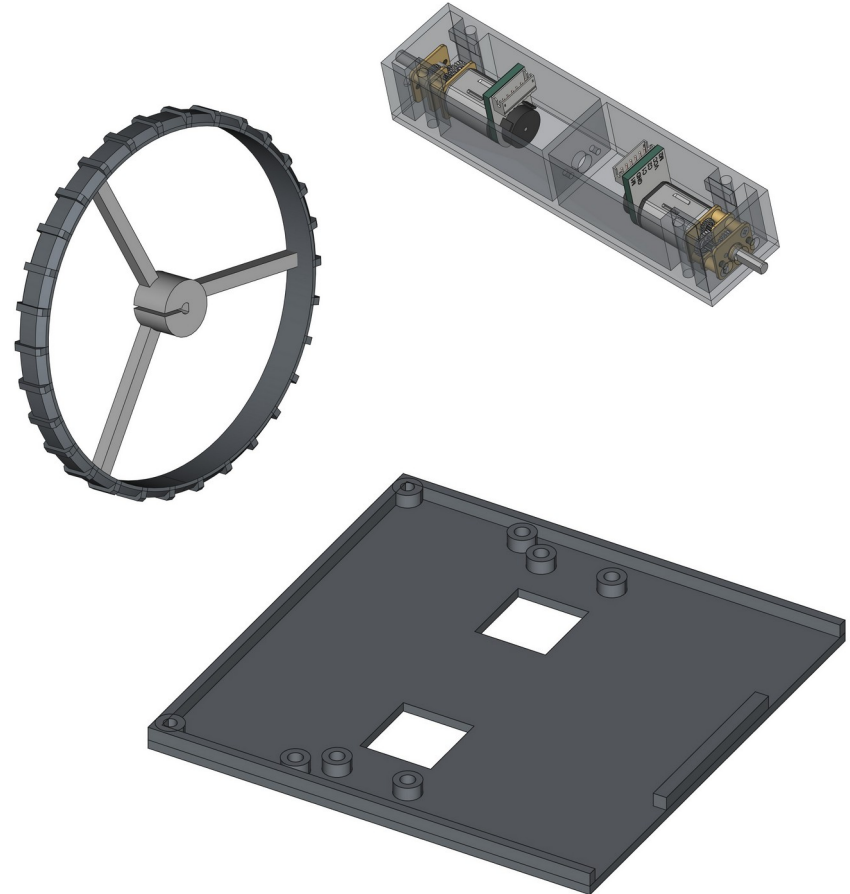
# UGV Base

- The power switch disconnects the battery from the UGV electronics and power connectors. The battery can still be charged with the power switch off.
- Near the center is a battery plug for connecting the battery to the UGV base controller.
- There are two sets of motor drivers. Each controls two motors. There are connectors on the board for connecting the motors.
- At the end of the board is a charger port for recharging the battery.



# 3D Printed Parts

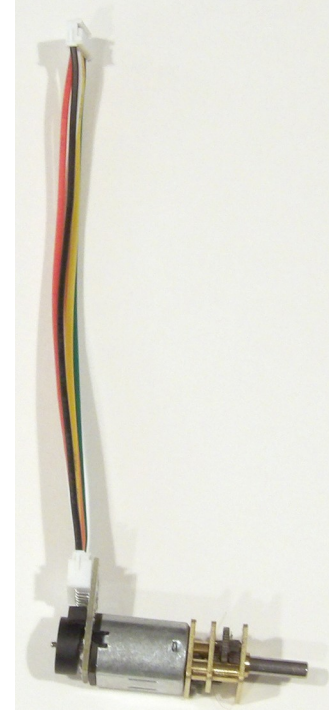
- There are multiple parts that require 3D printing.
  - Two motor mounts
  - Four wheels
  - Two bottom halves
- The parts can be printed in PLA, PETG, or ABS.
- Set infill to 15%.
- The layer thickness setting is not critical. 0.2 mm was used in the prototypes.



# Motor Assembly

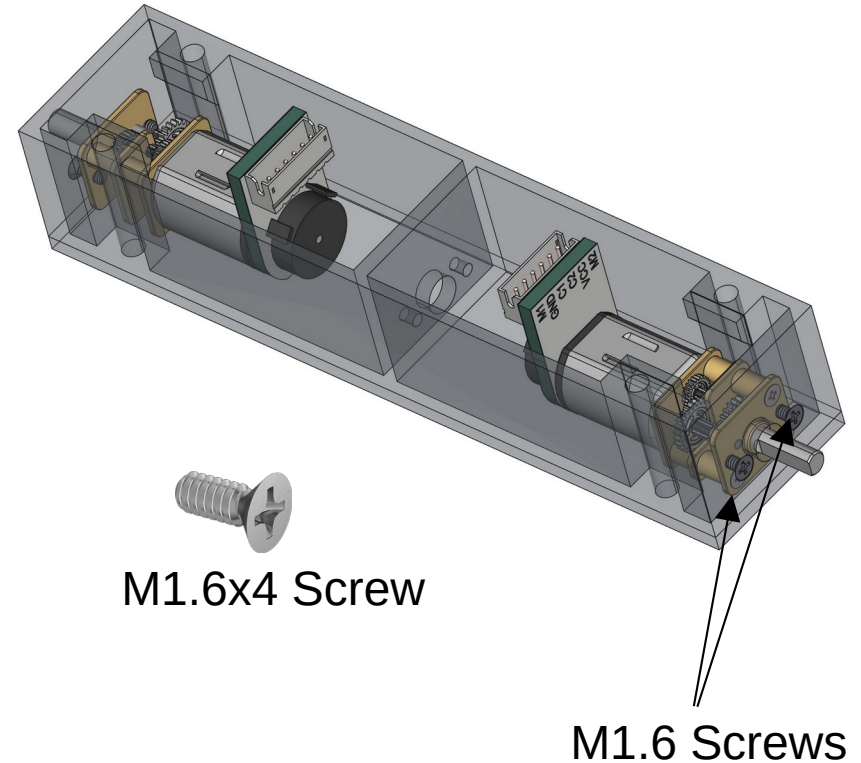
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- Install the cables into the four motors as shown.
- Try not pressing hard against the motor connector. Try pinching in the connector on both sides the connectors.



# Motor Assembly

- Insert a motor into the motor mount as shown so the shaft comes out of the center hole at then end.
- Secure the motor with two M1.6 screws. They are the tiny short flat top screws. A small #0 screwdriver or jewelers philips screwdriver will be needed.
- **Do not over-tighten as you may crack the plastic.**
- Install the rest of the motors the same way.



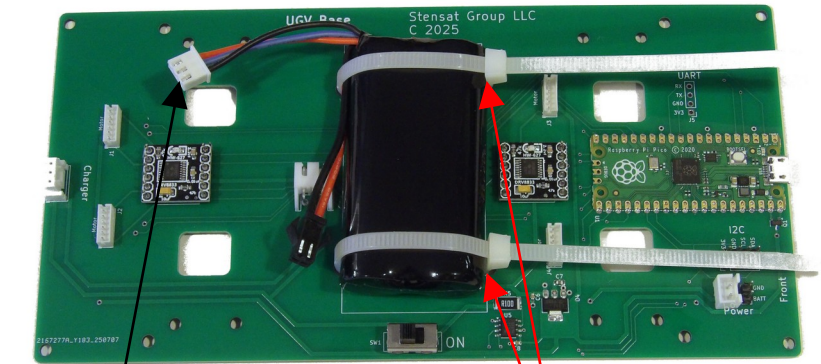
# Warning

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- **Warning** - The Lithium ion battery can produce a large amount of current, enough to start a fire.
- Be careful to not short the pins on the the battery connector or charger connector.
- Be careful to not let the connector contacts on the back of the UGV board come into contact with any conductive material.
- **The battery can be damaged from shorts. The UGV board will be damaged and a fire can be started.**

# Robot Platform Assembly

- Position the battery into the center of the UGV board. Orient it so the connectors are positioned to the top left of the picture.
- Secure with the two Zip ties.
- **Make sure the power switch is in the off position.**
- Do not connect the battery yet.

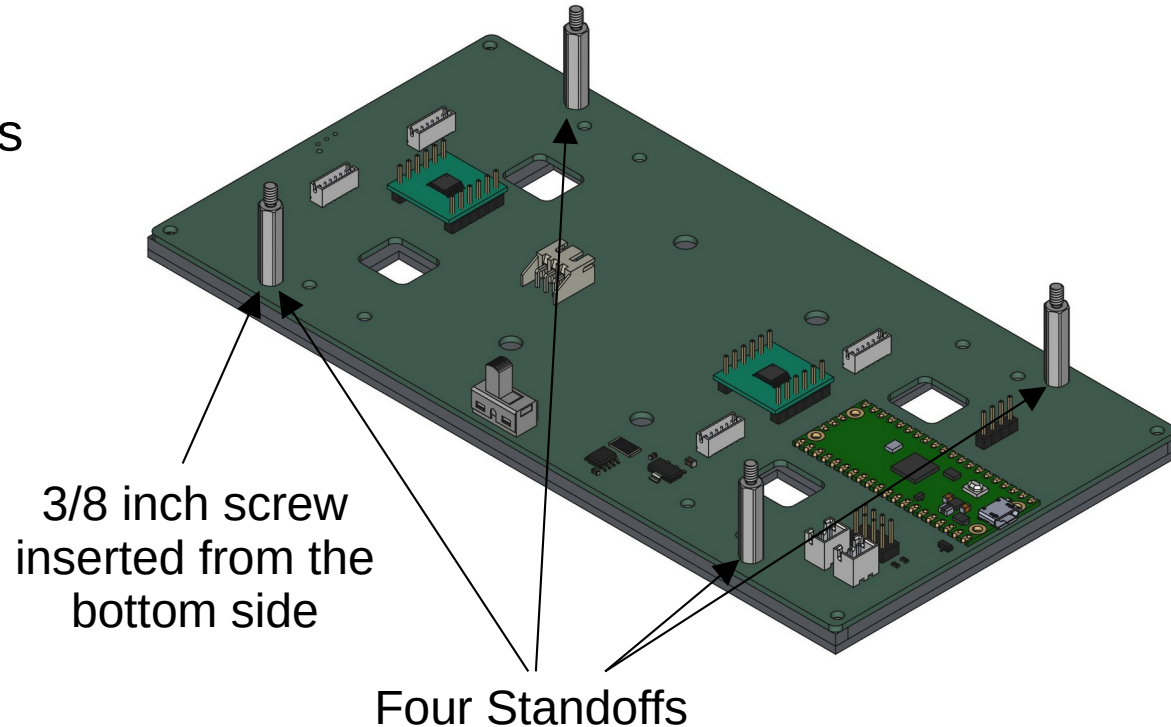


Battery  
Connector

Zip Ties

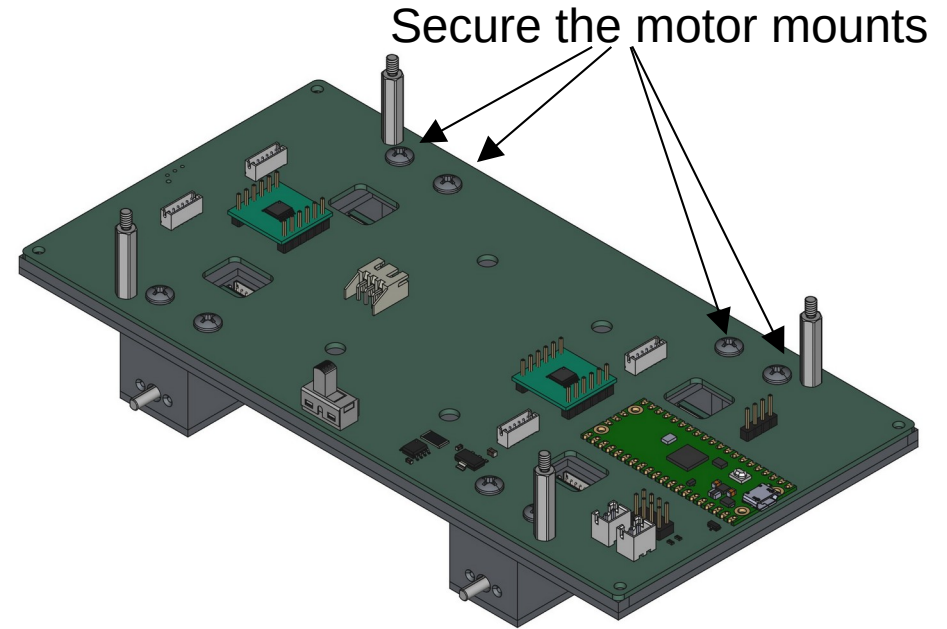
# Robot Assembly

- Align the bottom plates under the UGV board and insert the 3/8 inch screws in the locations shown.
- Secure the screws with the 1" standoffs.



# Robot Platform Assembly

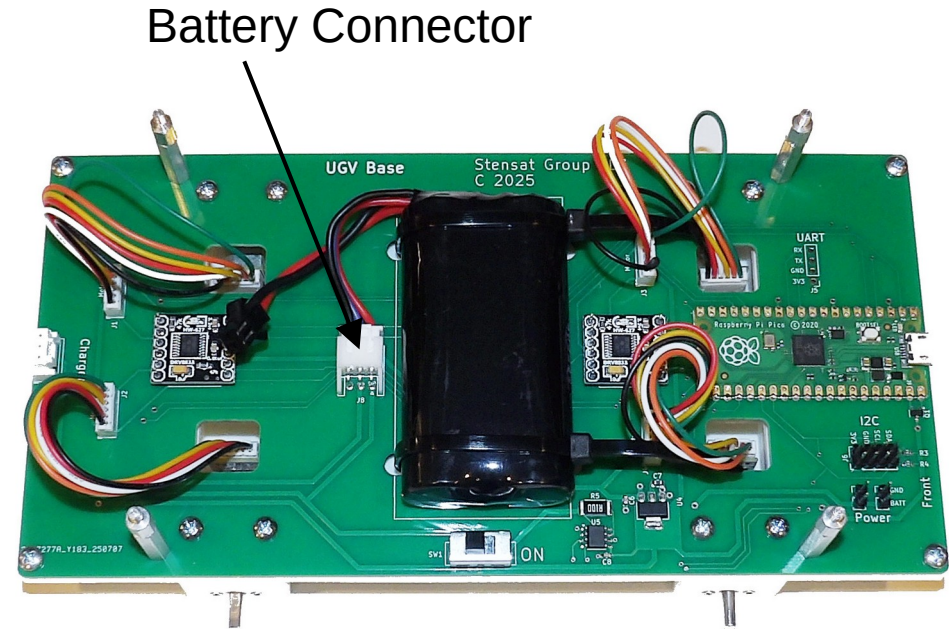
- Position the 3D printed motor mount under the UGV board and secure with four 1/2" long #4 sheet metal screws.
- Since the screw is threading the plastic holes, do not over tighten. Stop tightening when the motor mount is held snug by the screw.
- Install both motor mounts with the motors installed.



Sheet metal screw

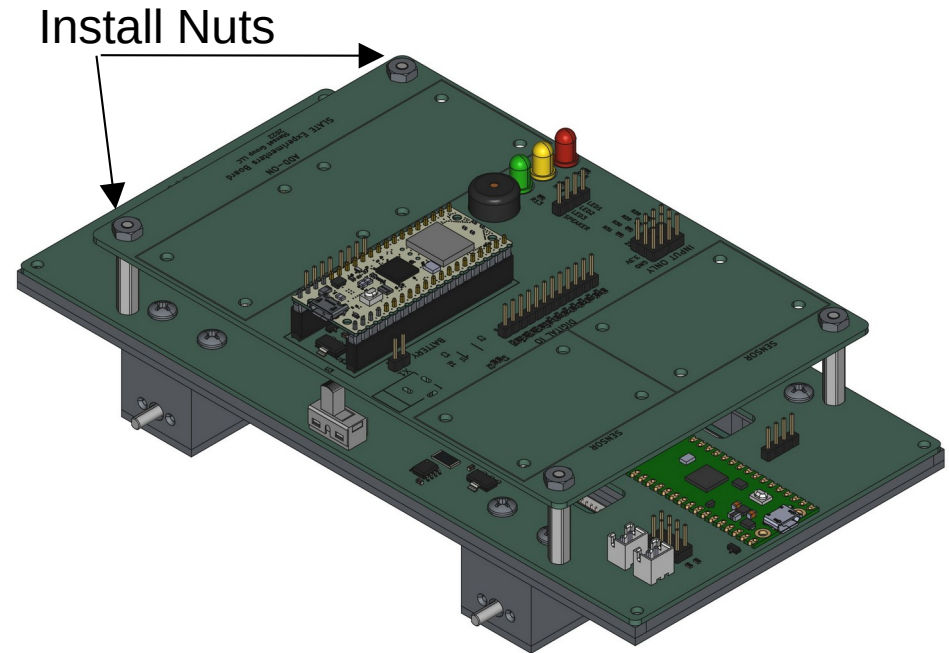
# Robot Platform Assembly

- Install the motor cable connectors into the UGV base board as shown.
- The connectors are keyed and insert in only one direction.
- Install the white battery connector into the UGV Base power connector. The connector is keyed so the battery connector plugs in only one way.



# Robot Platform Assembly

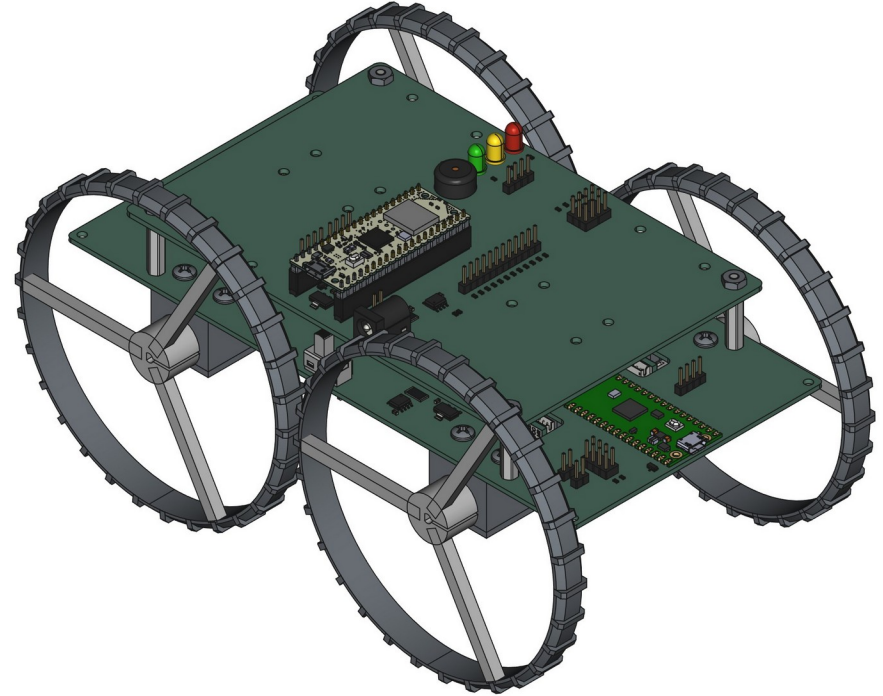
- Position the SLATE board on top of the standoffs and secure with four nuts.
- Gently tighten the nuts but don't go beyond snug or you risk breaking the aluminum standoffs.



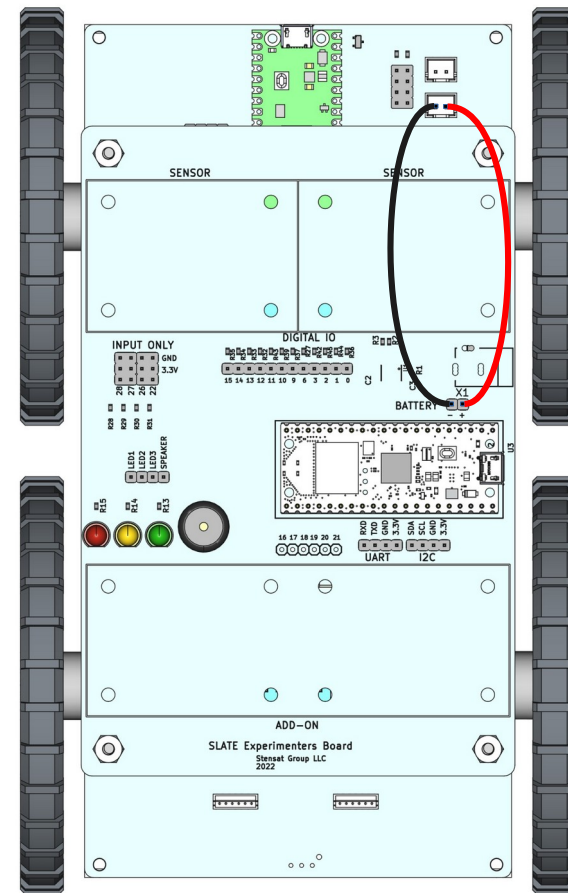
# Robot Platform Assembly

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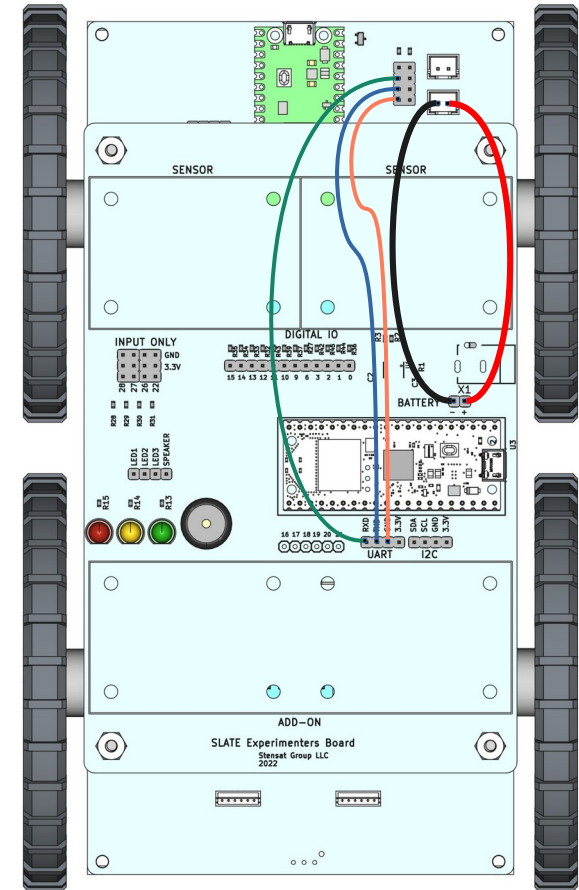
- Install the four wheels. The shaft has a flat side. Align the center hole with the flat side and push the wheel onto the shaft.



- The kit has two power cables with white connectors on each end.
- If the SLATE board has a white power connector like the UGV Base, install the power cable into both connectors.
- If you have an older SLATE board:
  - Take one and plug one end into the UGV Base board. Pick the end of the cable where the red wire is aligned with the BATT label on the UGV Base board.
  - Orient the other connector so that the red wire aligns with the + symbol on the SLATE board.



- Connect the I2C pins from the SLATE board to the I2C connector on the UGV board.
- Only connect GND, SDA, and SCL pins. **Do not connect 3.3V.**
- This completes the UGV assembly.



# Quick Test

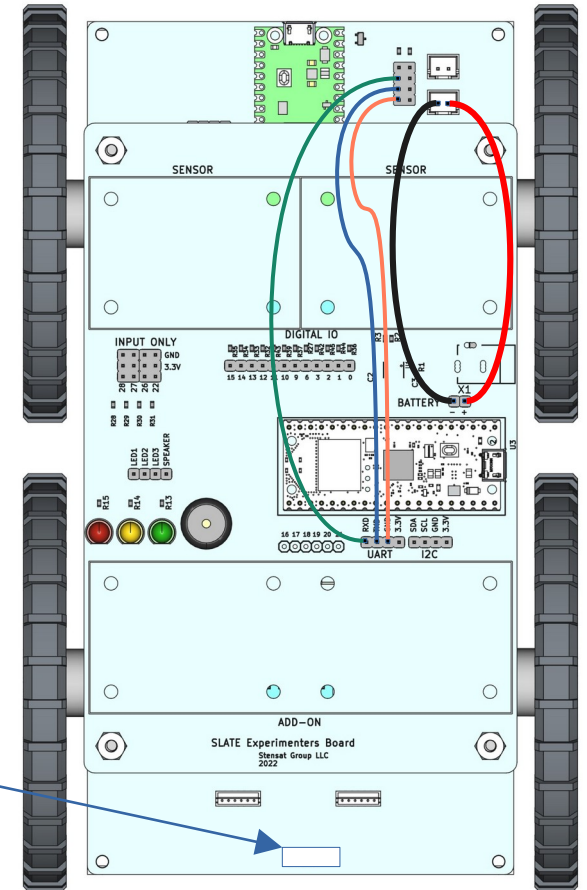
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- Turn on the power switch and check for LEDs.
- Each of the motor drivers should have an LED on.
- Each motor has a green LED. You should verify they are on which would indicate the motor cables were installed properly.

# Battery Charging

- There is a connector at the rear end of the UGV.
- You plug the charger into that connector.
- The charger plugs into a USB A port. It can be a laptop or a power module of at least 1 amp.
- The charger will start blinking a red light. When the charge is complete, there will be a solid green light.

Charger  
Connector



# 3D Printed Parts

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- The 3D printed parts were designed using an open source software package called FreeCAD. You can download a copy at [www.freecad.org](http://www.freecad.org)
- Source files and Step files are available.

# Wheel Design

- The critical part of the wheel is the hub. The hub has a 8 mm radius.
- The center hole is 1.58 mm radius.
- The flat part of the shaft is 1.04 mm from the center of the hub.
- The hub is notched to allow for a little flexing when the wheel is pushed onto the shaft. The gap is 0.95 mm.
- The dimensions are based on printing on a Prusa 3D printer.

