

Parts

Screws:

Type	Quantity	Use
M6 (6 mm Ø) 1.5 cm	10	Aluminum plate to the motor
M6 (6 mm Ø) 1 cm		80/20
½ in Ø	26	
¾ in Ø	12	
#8-32 2.5"	8	Fans
M5 (5 mm) Button cap screws		Shelving system and battery holders
#8-32 1"		Motor controllers

All other components are described in the [Parts Appendix](#).

Instructions

Exterior/Skeleton

For general construction of the wheelchair frame, refer to this [Fusion 360 file](#).

For general construction of the internal pieces of the box structure, refer to this [Fusion 360 file](#).

Building the Base:

To build the base of the wheelchair, upon which the box and chair will rest:

1. Gather all pieces necessary for assembling the base: parts PT-00017 and PT-00018.
 - a. Part PT-00018 will be used as the aluminum frame to support the base plates.
 - b. Part PT-00017 is the large base plate for the wheelchair system.
 - c. Part PT-00001 is the footrest plate, which is shorter than the base.
2. Line up the slide-in nuts (PT-00026) according to the placement of the holes drilled into (PT-00017).
 - a. Ensure that the orientation of PT-00017 is such that, once secured the L-shaped battery holder holes are facing according to the photo below.

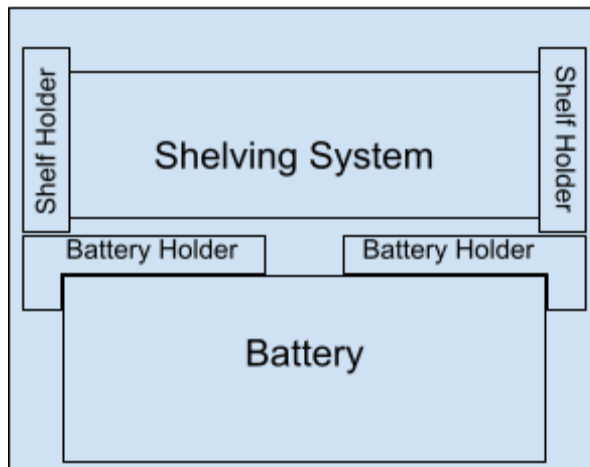


Fig. 1. Orientation of the components in the box enclosure on top of the base plate. Drawing not to scale.

3. Place screws (E) into each hole on one side of the plate (PT-00017). Use the appropriate sized hexagon key wrench to ensure the screw has cleared both holes, and do not fully tighten the screws in place. Only tighten screws enough to ensure the screw is firmly in the slide-in nut, and the screw head lays completely flat against the plate. As screws are being inserted, ensure proper alignment of the screws, the plate holes, and the slide-in nuts.
 - a. If difficulties are encountered with the slide in nuts not laying flat within the middle groove of the framing rails, push the nuts out with a small tool and re-align. If the slide-in nut hole appears stripped, replace it with a non-stripped slide-in nut.
 - b. If the screw threads appear stripped, use the key wrench to take out the screw and replace it with a non-stripped screw.
4. Repeat this process on the other side of the base plate.
5. Once the left and right sides of the base plate are in place, take the two framing rails (PT-00018) and lay them flat against a table or similar flat surface.
6. Next, take (PT-00017) and place it on top of the framing rails, ensuring that the holes on the left and rightmost sides align with the grooves of the rails.
7. Using the help of a partner, slowly slide the plate (PT-00017) and align the slide-in nuts with the grooves of the rails. Slide the plate into place and ensure the plate is flush with the framing rails.
8. Once proper alignment is guaranteed, fully fasten the screws into (PT-00017).

Building the Footrest:

1. Gather all pieces necessary for fastening the footrest plate, including parts PT-00018, PT-00017, and PT-00001.
2. First, place three screws (PT-00026) on each side of (PT-00001).
3. Then, on the bottom of (PT-00001), align slide-in nuts (PT-00026) with the screws.
4. Using the hexagon key wrench, fasten the screws into the nuts, just enough to ensure the screw head lays completely flat against the plate.

5. Once completed, align the screws and nuts on the left and right sides of the footrest plate (PT-00001) with the middle groove of (PT-00018).
6. Slide the footrest into place. Using the help of a partner, slowly slide the plate (PT-00001) while aligning the slide-in nuts with the grooves of the rails. Slide the plate into place and ensure the plate is flush with the framing rails.

Building the Box:

There needs to be parts PT-00021, PT-00022, and PT-00023 along with 56 screws and 56 sliding nuts 20 angle brackets. The final product can be shown [here](#).

1. Create a square using PT-00022 and PT-00023 to be an 18in by 18in. Insert two sliding nuts on one side and one sliding nut on the next side on each 80/20.
2. Take the corner brackets (PT-00029) and place them on the inside corners of the current square. Screw PT-00029 to keep the square together.
3. Repeat steps 1 and 2 a second time.
4. Take PT-00021 and insert two slide nuts on one side of each 80/20. Place another sliding nut on each of the outside slits of each square.
5. Place them in each corner of one of the squares. Place angle brackets screw them together.
6. Lastly, attach the other square to the 10in 80/20 with angle brackets to complete the box.

Attaching Box to Base:

There needs to be 12 PT-00026 total, along with the existing box itself and the base.

1. 3 PT-00026 needs to be placed in the bottom slit of each of the 80/20 pieces on the bottom of the box. They need to be placed so that they will line up with the holes in PT-00017.
2. The box should be placed onto the aluminum so the screw holes line up.
3. From underneath the base, screw in 12 screws (short 80/20 screws) into their respective holes.

Attaching Box Components:

After the box frame is securely attached to the base plate, it is necessary to secure the various components that will house electronics within the box. This includes the battery holders (PT-00004), which includes a space to house the charger, and the shelving system (PT-00013), which holds the electronics and the fans. See Fig. 1 above for a diagram of the box component organization.

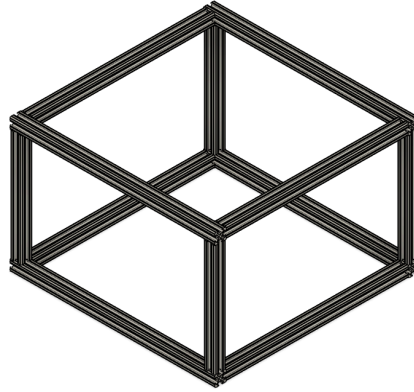


Fig. 2. Box frame composed of 80/20 aluminum. Drawing created in Autodesk Fusion.

1. Attach the battery holders (PT-00004) such that from the front view, the battery holder which doubles as a charger holder is facing the left side of the chair. From the point of view of a patient sitting in the chair, the battery/charger holder should be on the right side of the chair. The holders should be arranged such that they secure the battery, which will rest at the front of the box against the 80/20.
2. Ensure both battery holders are secured according to the hole placements drilled into the base.
3. Place the battery in between the shelf holders and the box frame. It should be flush against the frame.
4. Attach the shelf holders (PT-00013) to the base plate. Ensure that the holders are flush within the 80/20 box. There should be no gaps between the battery holders and the shelf holders.
5. Obtain the top (PT-00016) and bottom (PT-00005) shelves to the shelf holders.
6. For the top (PT-00016) holder, place these electronics on the shelf.
7. For the bottom (PT-00005) holder, place these electronics on the shelf.
8. Slide the shelves into place within the holder.

Attaching the chair to the box:

To attach the chair to the box, the bottom of the chair must first be disassembled. Then, using the preset screw nuts, it is possible to connect with PT-00023 to create a T-shaped connection to the box.

1. First, disassemble the chair bottom.
2. Use PT-00023 to form a π -shaped part using 2 angle brackets and 2 T-brackets.
3. Using 4 angle brackets, connect the π -shaped part to the bottom of the chair.
4. With the made combination with 6 angle brackets, connect the π -shaped part to the top of the box.
5. Ensure all brackets are flush with the 80/20 and that screws are tightened appropriately to minimize wiggling.

Attaching the Light Stand:

To attach the light stand to the back side of the robot, assembly will require:

- 36 x 0.25 inch screws and 1-inch T-slot nuts.
- 4 x 90 motor connectors
- 4 x T motor connectors
- 6 x angle brackets

First, make the stand itself:

1. Attach both PT-00024 to the ends of one PT-00025.
2. Attach the final PT-00025 on the other ends of both PT-00024.

Then, connect the stand to the rest of the chair:

1. Connect the four T motor connectors to the back of PT-00023.
2. Attach the rest of the built stand to the T connectors by the shorter side, ensuring that it is symmetric.
3. Add PT-00009 onto the top of the light stand, ensuring symmetry.
4. Attach PT-00037 and the light onto PT-00009, with PT-00037 facing forward towards the bottom, and the light on top towards the back.

Attaching the Covers:

To attach one of the covers on the side, three M6 (6 mm Ø) 1 cm screws, one M6 (6 mm Ø) 1.5 cm screw, and PT-00014 are required.

1. Place PT-00014 underneath PT-00027 on the side of the box.
2. Use the three M6 (6 mm Ø) 1 cm screws to screw through the bottom, left, and right holes in PT-00014.
3. Screw in the M6 (6 mm Ø) 1.5 cm screw through the PT-00029 attached to PT-00027 and through the top hole of PT-00014.
4. Secure all screws and ensure they screw through each of the PT-00026 inside each of the PT-00022 and PT-00023.
5. Repeat all of these steps on the other side of the robot with the other PT-00014, three more M6 (6 mm Ø) 1 cm screws, and one more M6 (6 mm Ø) 1.5 cm screw.

Attaching the Screen Stand:

1. Assemble the screen stand using the given manual from the manufacturer.
2. Attach the screen on the left or right side of the wheelchair using the vice grip around the middle, avoiding interference with the motor and front wheels.
3. Take the screen and screw it into the brackets.
4. Plug in wires and keep cables within the cable management holders.

Attaching the Joystick/Biometric Sensor:

Attaching the Joystick and Biometric sensor requires:

- 4 x 8-32 screws
- 4 x 0.25 inch screw
- 4 x 2M screws
- Joystick screws
- 1 x 0.25 inch screw
- 4 x 4-40 screws and spacers
- 3 x angle brackets and six 0.25 inch screws.

Follow the order of attaching the components as described below:

1. Attach PT-00031 to the original armrest spot.
2. Attach both PT-00032 to both ends of PT-00031 and PT-00033 to connect them together.
3. Attach a PT-00041 to the front of PT-00033.
4. Attach the biometric sensor in the spot delegated for it on PT-00033.
5. Attach PT-00038 to the bottom of PT-00033 through the hole made for it.
6. Attach the PCB to the bottom of PT-00034, and plug in all needed connections to it.
7. Attach PT-00034 to the bottom of PT-00033, underneath PT-00038.
8. Attach both switches to the rectangular holes in PT-00033
9. Once all armrest parts have been connected, attach PT-00028 to PT-00018 beneath PT-00034 so it stabilizes the entire design.
10. Add the smaller support bar for extra support if needed.

Attaching the Speakers:

1. Using VELCRO tape strips, cut the tape into appropriately-sized circular pieces which completely cover the bottom of the speakers.
2. Attach the sticky side of one side of the tape to the speakers, and the other piece to one side of the wheelchair's side covers.
3. Repeat this on the other side of the robot, ensuring symmetry of the speakers and proper adhesion of both sides of the tape.

Motor & Battery System

1. Connect the motors to their respective motor pads, the screws go down into the motor
2. Then you screw the washer into the platform
3. Tape the unused wires coming from the motors
4. Solder the motor wires to the respective motor controller.

Attaching the wheel to the motor to the base

1. Using the Motor provided nuts and shaft for the keyed hub, look for back wheels that fit the keyed hub.

2. When the wheels are acquired, the assembly should be straightforward with pushing the wheels in the fitted keyed hub, then pushing the keys in and finishing it with the nuts to secure the wheel to the motor.
3. Using components PT-00011 and PT-00012, connect the top of the motor to the base 80/20 using 10 6mm screws.
4. Finally, connect the assembly to the base 80/20 using the PT-00011 and PT-00012 built in screw holes on the sides. To do this, 12 x 0.25 in screws are required. The final design should look like Figure 3.

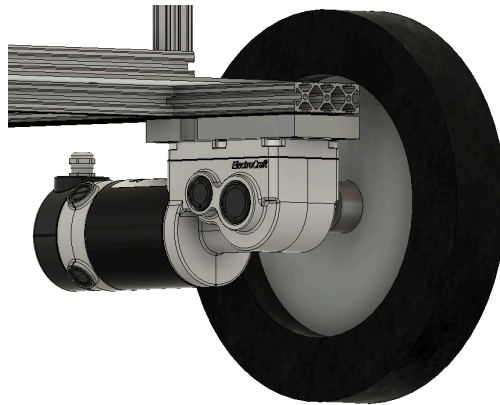


Fig. 3. Wheel and motor attachment and orientation. Drawing created in Autodesk Fusion.

PCBs

There are five different boards that need to be assembled to construct the wheelchair. These boards are:

- Sensor Mainboard
- Joystick Daughterboard
- Motor Mainboard
- Power Distribution Board
- 5x PIR and Ultrasonic Sensor Boards

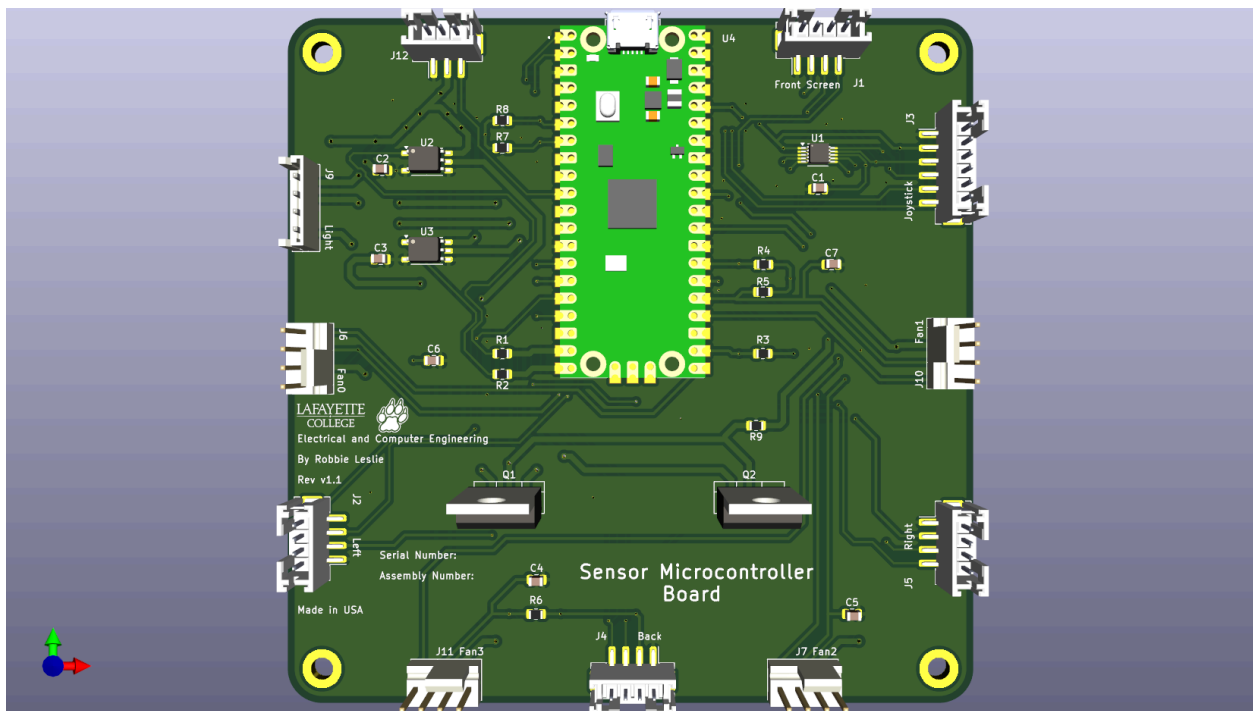
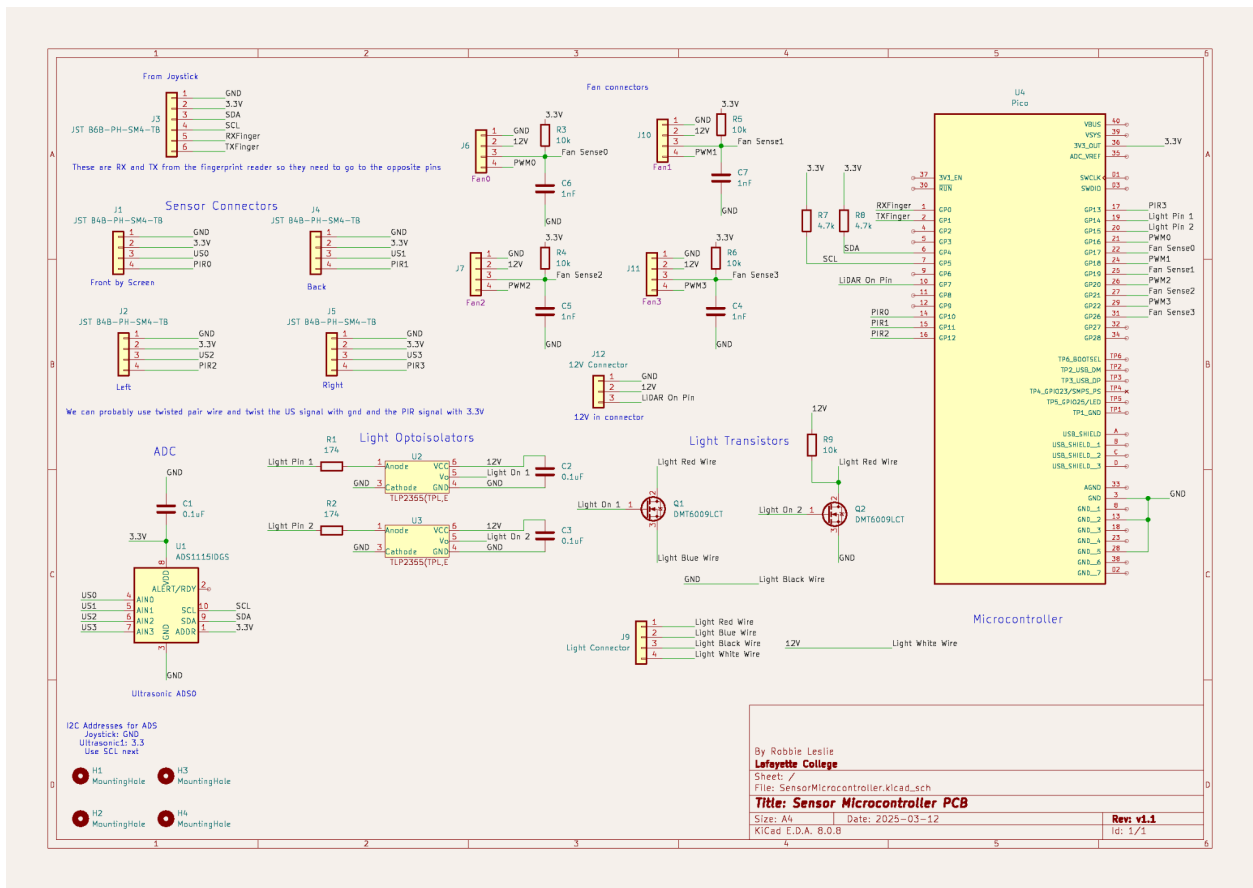
All the boards have reference designators on them to make assembly easy. The schematics should be referenced during assembly to ensure parts are placed correctly. The schematics are provided here, although it is easier to reference them in KiCAD directly. The PCB projects can be found on the team's GitHub. All the components have the manufacturer part number as a field so that a BOM can be easily exported for each design. KiCAD automatically generates 3D models of PCBs. Those have been included with the schematics for reference, although opening them in KiCAD is more useful.

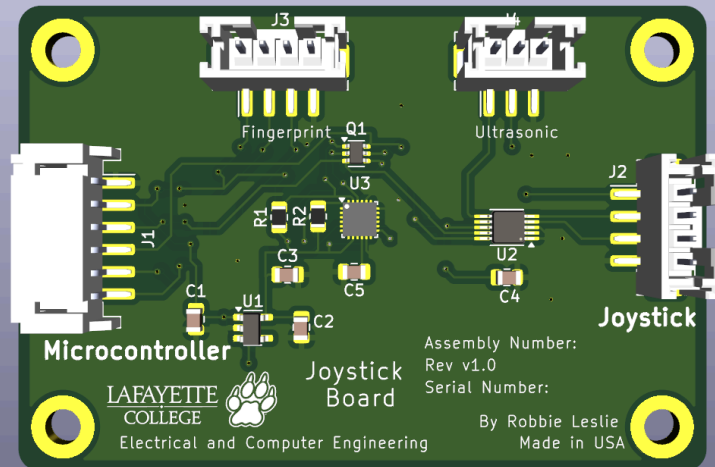
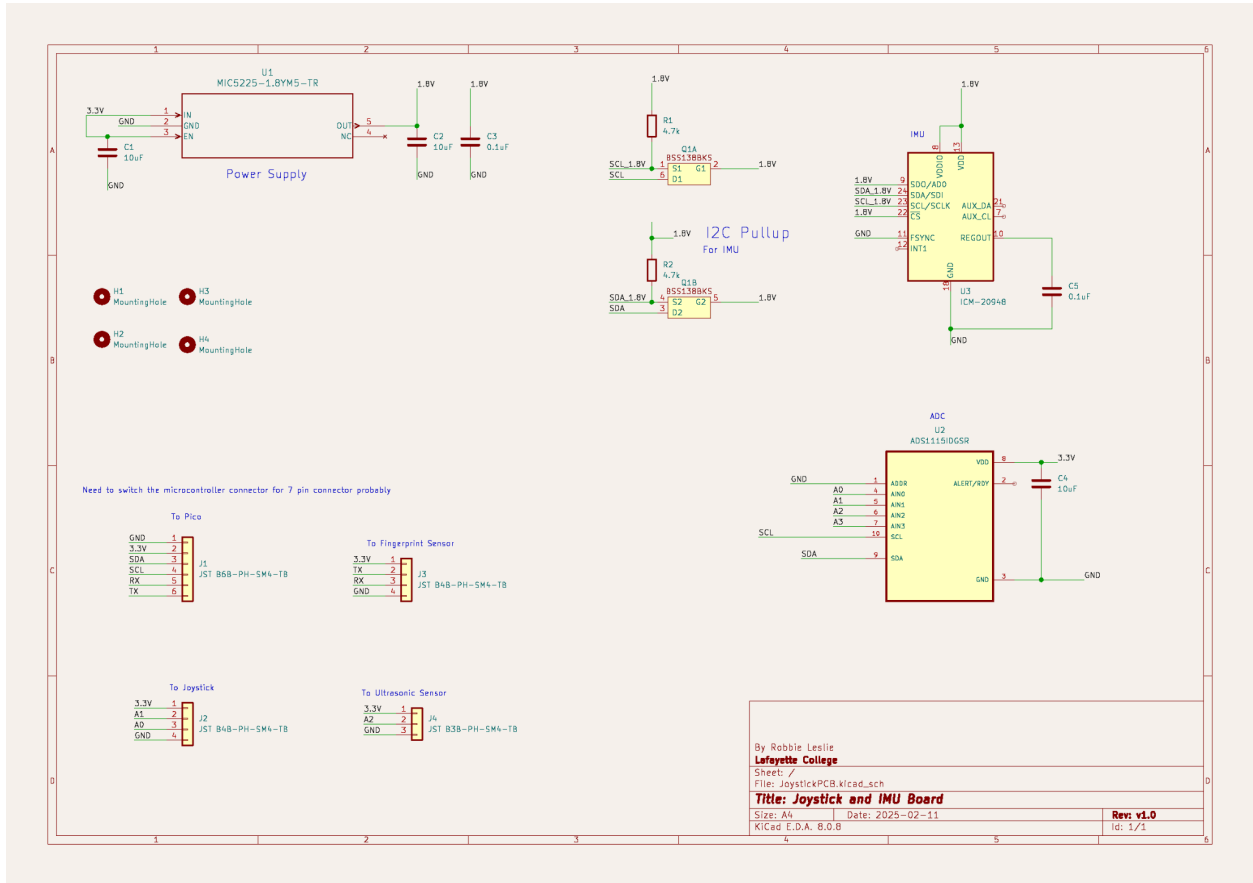
Assembly:

The PCBs mostly use surface-mount components. As such, solder paste should be applied to the board, and then the components should be placed. Then, the components should be

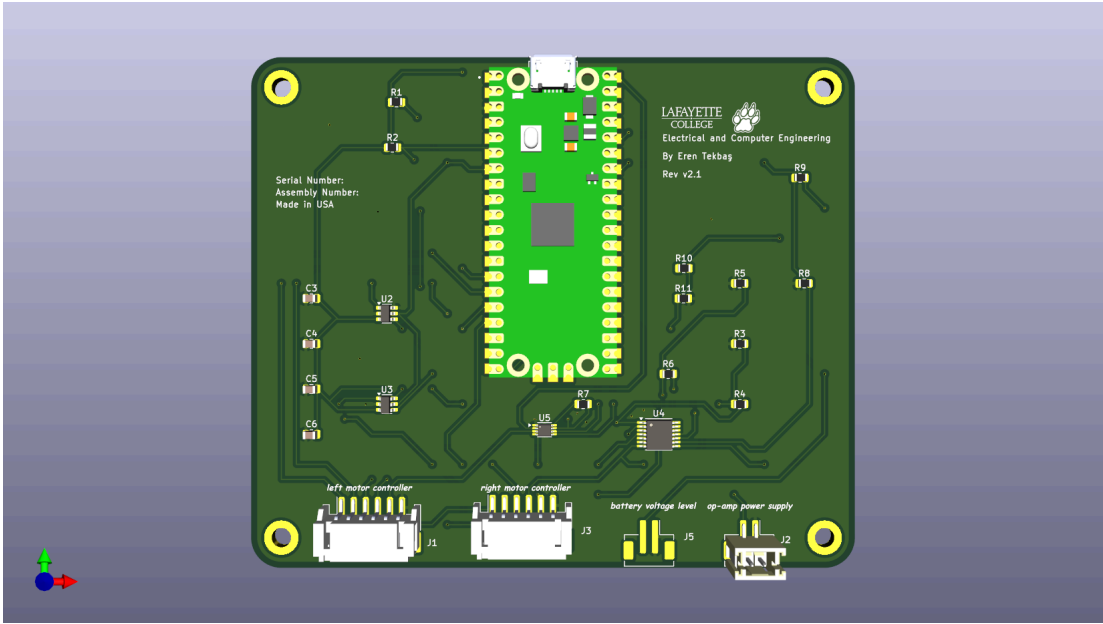
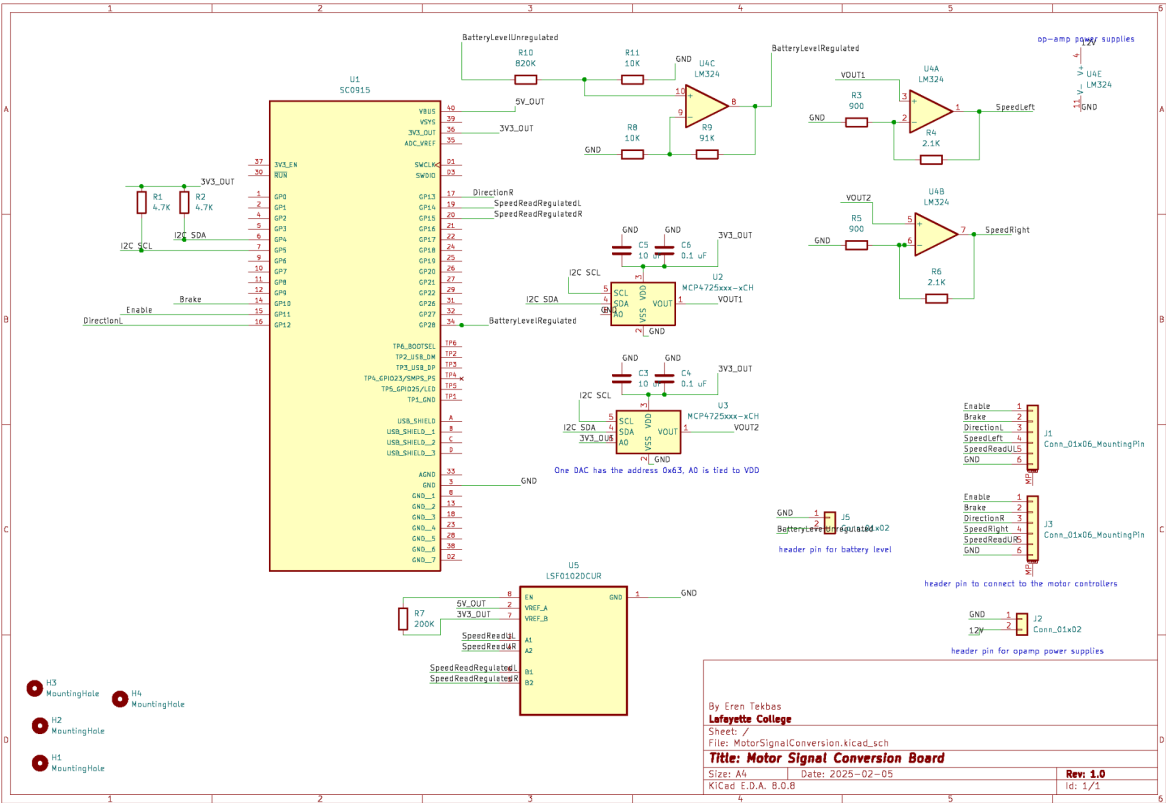
soldered using the PCB oven. If a board has through-hole components as well as surface-mount components, the surface-mount components should be soldered first.

Sensor Mainboard Schematic

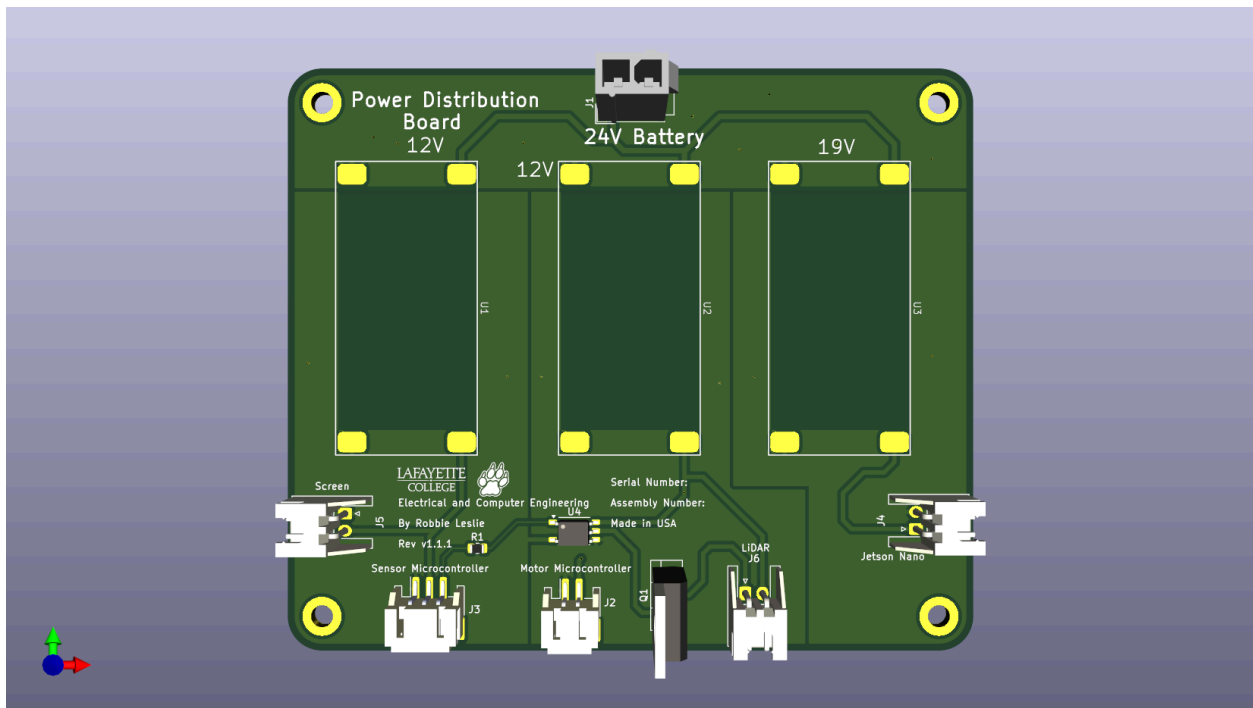
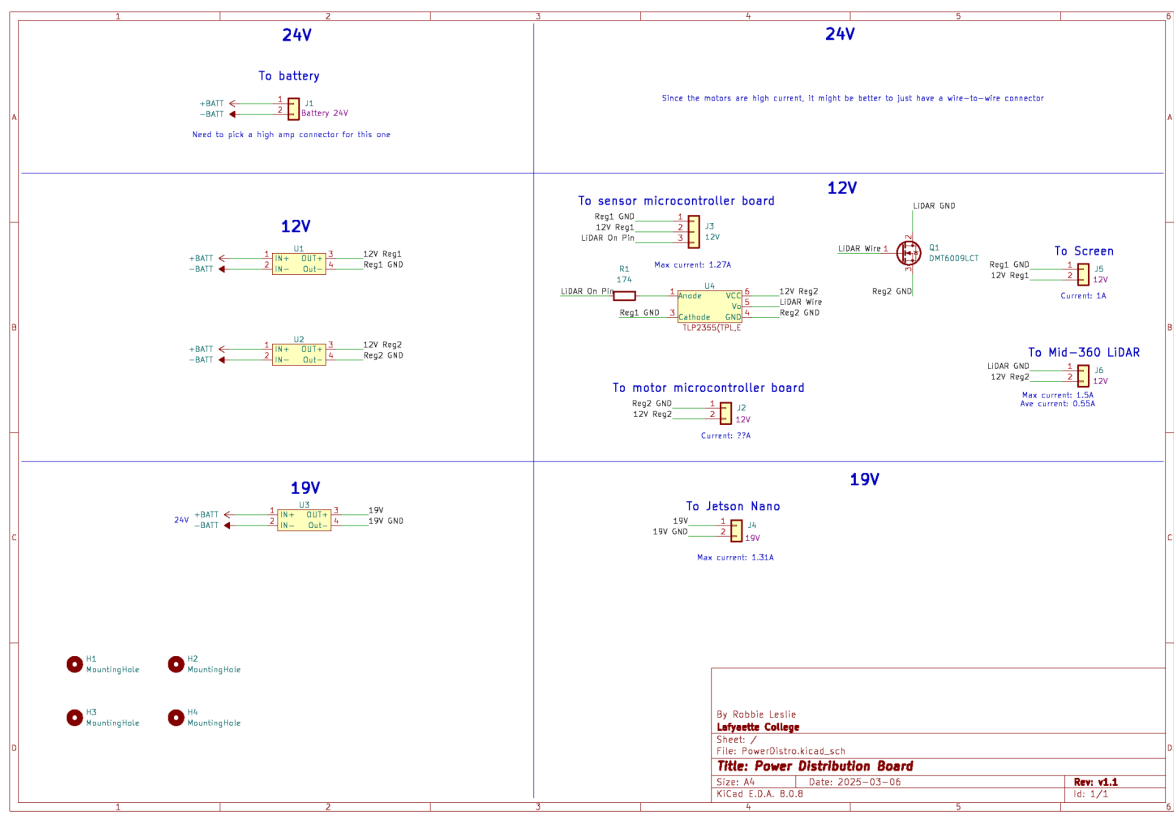




Motor Mainboard Schematic



Power Distribution Board Schematic



PIR Ultrasonic Sensor Board Schematic

