

Lab 2, 2.12 Spring 2023

Assembly Instructions (All necessary tools are included)

A. Mechanical Assembly

1. Find a level and clear surface to spread screws out onto
 - a. Save your plastic box and use an index card (lab section and your name). Later in the semester you will need to dis-assemble your robot arm and store all components in your box.
 - b. Inform one of the instructors for any missing/broken parts.



Figure 1: Pre- and Post- assembled Kit

2. Attach base link to the wood spacer (see Figure 2-Figure 4 for reference).
 - a. Remove the paper backing/sticker from linkages if any.
 - b. Match washers, screws, and nuts to each other. Be sure to use washers between the screws/nuts and the wood. You may have a few extra fasteners.
 - c. Drive the three screws into the spacer using the included screwdriver. Be sure to place washers as shown (Figure 4), both here and in future instructions.

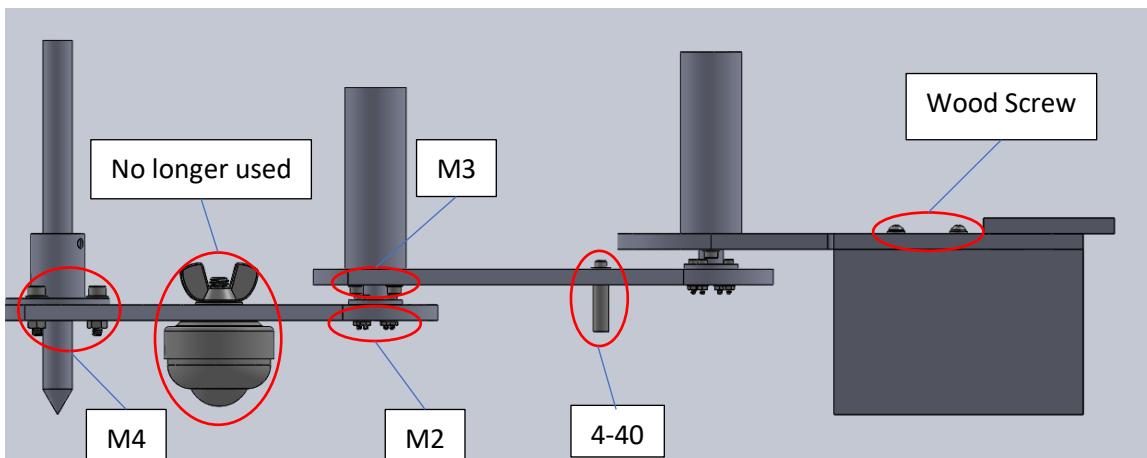


Figure 2: Fastener Labels

3. Partially install the setscrews into the hubs (Figure 3)
4. Attach one hub to “link 1” and one hub to “disk” (see Figure 3)
 - a. Match the bolt patterns
5. Attach one motor to “base link” and one motor to “link 1”
 - a. Match the bolt patterns
6. Attach motors to hubs using the set screw
7. Attach the penholder (Figure 5) to “link 2” by matching the bolt pattern. You will use this link in a future lab.
 - a. Install dry erase marker using the screw in the penholder to press into the side of the marker.
8. Attach the hard-stop.
9. Clamp the wood spacer block to the bench after assembly is complete.
10. Make sure the robot's workspace is clear from any obstacles.

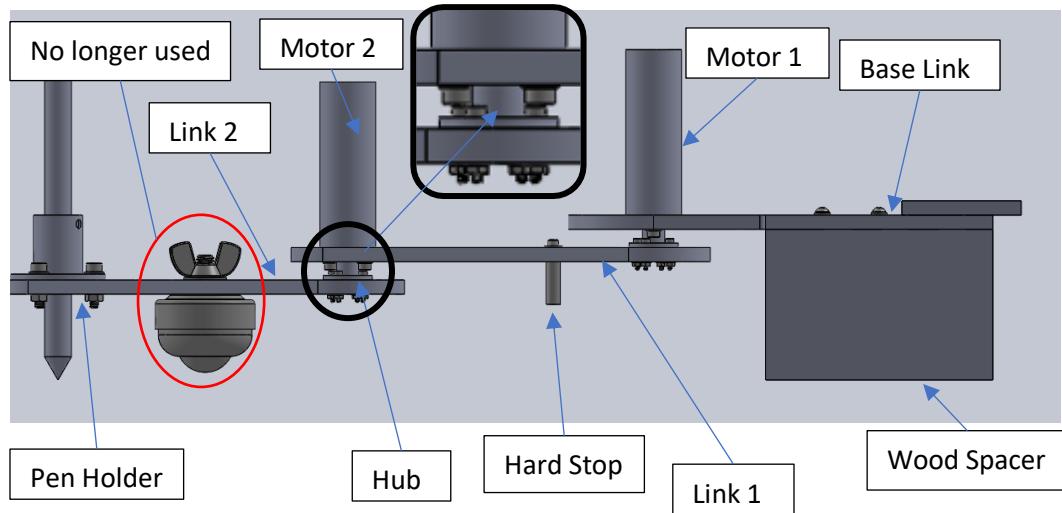
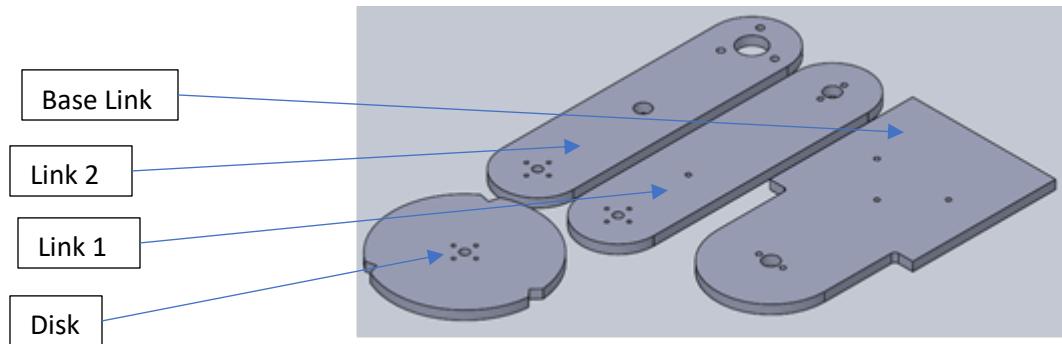


Figure 3: Component Labels

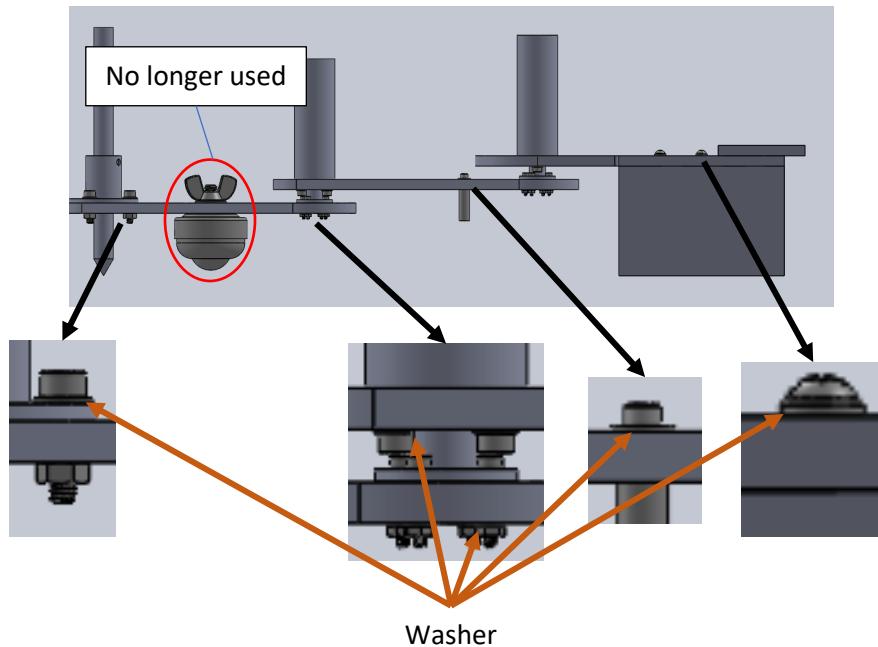


Figure 4: Washer Placement



Figure 5: Penholder

B. Motor Wiring

1. Assemble the Arduino and motor controller.
 - a. Install the motor controller onto the Arduino as shown in Figure 6.
 - b. You will need to extend the jumper wires to the most distal motor by connecting a pair of male-female jumper wires in series.
 - c. Change the motor controller board's jumpers to "PWRIN," as shown in Figure 7.
 - i. This allows the controller to pull energy from the DC power supply that is plugged into the power outlet in your wall. When the motor shield is powered by an external power source in this way, the external power source and Arduino must have the same GND. This means that your

computer will need to be plugged into the wall if it is powering the Arduino through a USB cable.

2. Wire up the motor

- a. You can keep the ribbon of six jumper wires going from the motor to the motor controller connected, in order to keep your wires organized if you like. This means that you would not be following the color pattern shown in the diagram.
- b. Connect the motor wires (black and red) to screw terminals on the controller board (Figure 8).
 - i. Motor 1 (Base Motor) power terminal (black) > M1-
 - ii. Motor 1 (Base Motor) power terminal (red) > M1+
 - iii. Motor 2(Elbow Motor) power terminal (black) > M2-
 - iv. Motor 2 (Elbow Motor) power terminal (red) > M2+

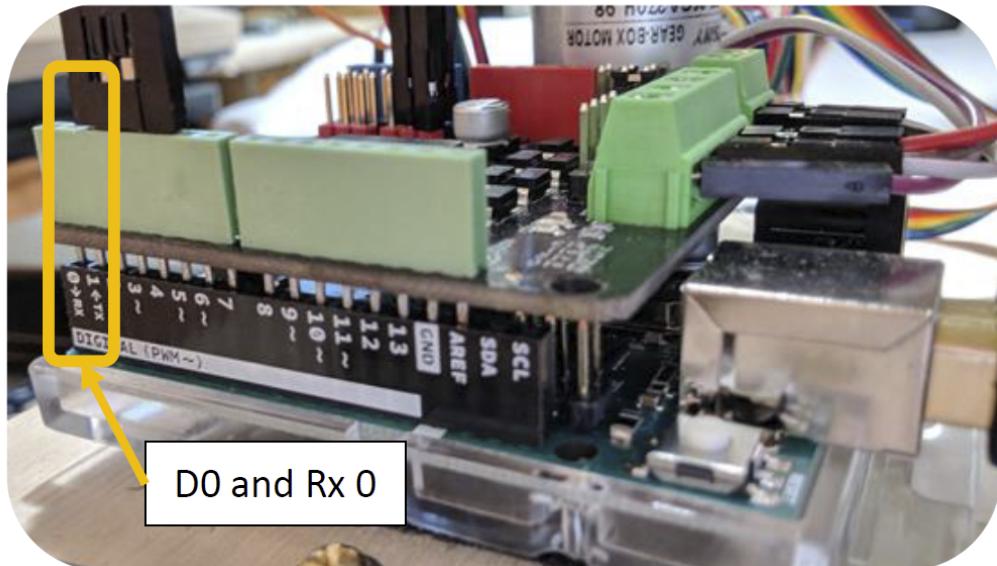


Figure 6: Motor controller shield installed on the Arduino. “Digital pin 0” on the Arduino is to be aligned with “Rx 0” on the motor controller board.

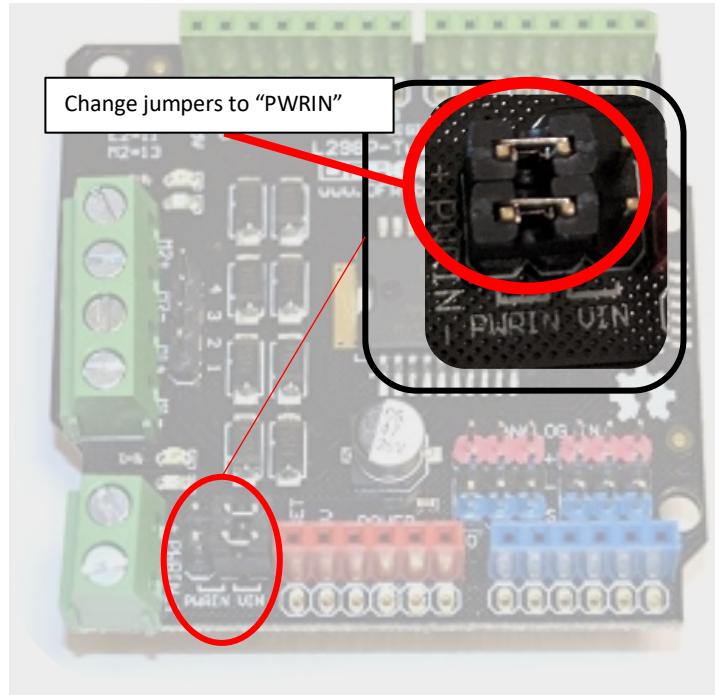


Figure 7: Set the power input to be from the external supply. Inlay shows the jumpers in the PWRIN position. You may need to change this when you receive your kit.

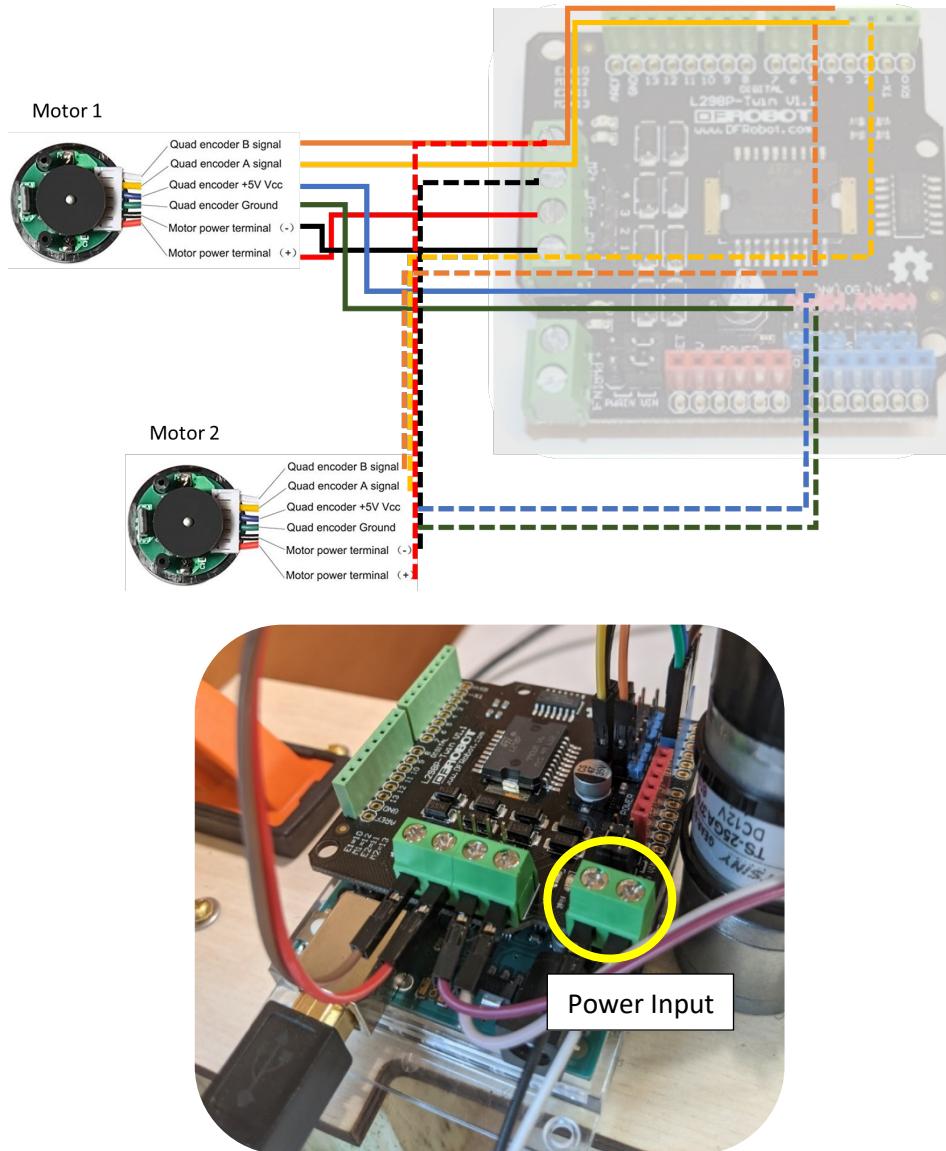


Figure 8: Wiring diagram (Top). An example system that has been wired up (Bottom Left). Your wire colors do not need to match those of the wiring diagram. The power connection on the motor controller board is indicated by the yellow circle. Female-Fema

C. Encoder Wiring

1. Connect the encoder wires to the controller board (Figure 8)
 - a. Motor 1 Encoder B > Digital Pin 4
 - b. Motor 1 Encoder A > Digital Pin 3
 - c. Quad encoder +5V Vcc > +5V
 - d. Quad encoder Ground > Ground
 - e. Motor 2 Encoder B > Digital Pin 5

- f. Motor 2 Encoder A > Digital Pin 2
- g. Quad encoder +5V Vcc > +5V
- h. Quad encoder Ground > Ground

D. Other Relevant Connections

1. Figure 9 illustrates how to connect the motor controller to a power source via the emergency stop. Do not do this until you are instructed to do so by the lab instructors.
 - a. The negative pin on the DC barrel adapter pairs with the negative pin on the motor controller board, and same for the positive pin (Figure 8).

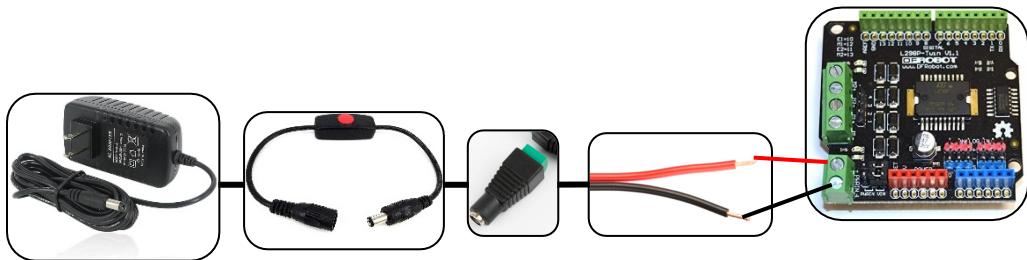


Figure 9: Assembly diagram for emergency stop