

Instruction Manual

Congratulations on printing your own prosthetic arm! You are one step closer to obtaining the final product. Contained within this manual is a compilation of steps necessary to assemble the arm. Please follow these steps in chronological order to ensure efficient and effective assembly.

*NOTE: ENSURE YOU HAVE A HTM 128PC SCREWDRIVER TOOLKIT OR SOMETHING SIMILAR FOR EASE OF ASSEMBLY

Finger Assembly

- Materials needed:



- Step 1: Take the first section of a finger (ex. Point 1 or Ring 1) and insert a torsion spring into the hole.



- Step 2: Take the second section of a finger (ex. Point 2 or Ring 2) and insert that piece into the opposite end of the same torsion spring. (Note: The words on each finger help with assembly.)



- Step 3: Once the outer holes of the second section, inner holes of the first section, and the torsion spring are aligned, insert a 1.75 mm diameter piece of filament (unprinted) through all the pieces.



- Step 4: Cut one or both ends to fit the width of the finger. (Note: A soldering iron may be used to flatten the end of unprinted filament to secure the connection)



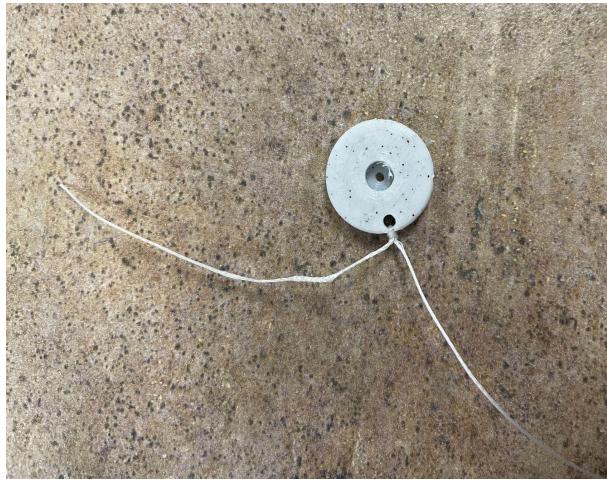
- Repeat Steps 1-4 for the first two sections of all five fingers.
- Repeat Steps 1-4 for sections two and three of each finger for all five fingers.
- After completion of all these steps, you should have something that looks like the following picture. (Note: The thumb only has two sections, just like a human hand.)

Palm Assembly

- Step 1: Assemble palm sub assembly

Palm Sled Sub-Assembly

- Step a: Tie a 2 foot long strand of ‘Spider Wire’ to 3 servo spools. The suggested knot to use is the Palomar knot. (<https://www.animatedknots.com/palomar-knot>)
Tie two, 2 ft long ‘Spider Wire’ strands to the last servo spool.
 - Place the spool with 2 strands on it to the servo that will eventually control the middle and ring fingers.



- Step b: Fasten spool to servo actuator with provided M2.5 screw (flat-ended)
 - NOTE: When assembling the right hand, top two servos should be oriented towards the right, bottom left servo should be oriented towards the left, and bottom right servo should be oriented upwards.
 - NOTE: Be sure to orient the spools rotationally as closely as possible to the images shown below



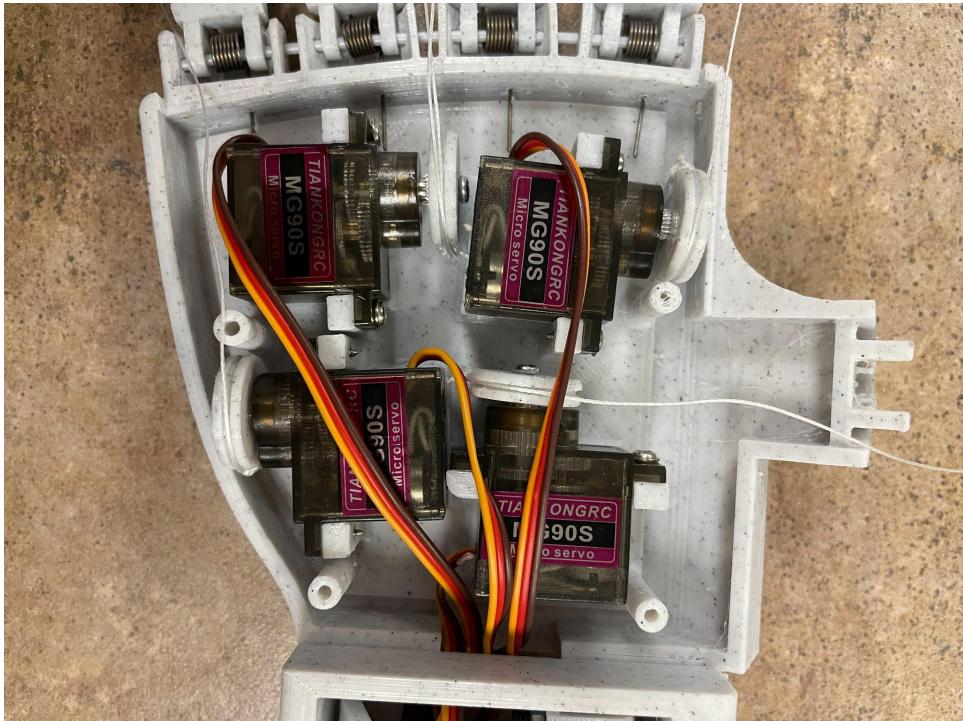
- Step c: Line up the mounting holes on any of the four servos with the mounting holes on the standoffs of the sled



- Step d: Fasten servo motor to standoffs with two provided M2.5 screws (sharp-ended)
- Repeat steps b-d for the other three servos



- Step 3: Place sub assembly in bottom palm by lining up holes on bottom side of sled to pins in the bottom palm part



- Step 4: Place each finger in its place on the palm bottom. Thread a 1.75mm piece of filament through each flange of the palm, finger, spring, finger, and palm for pinky, ring, middle, and pointer (in that order).



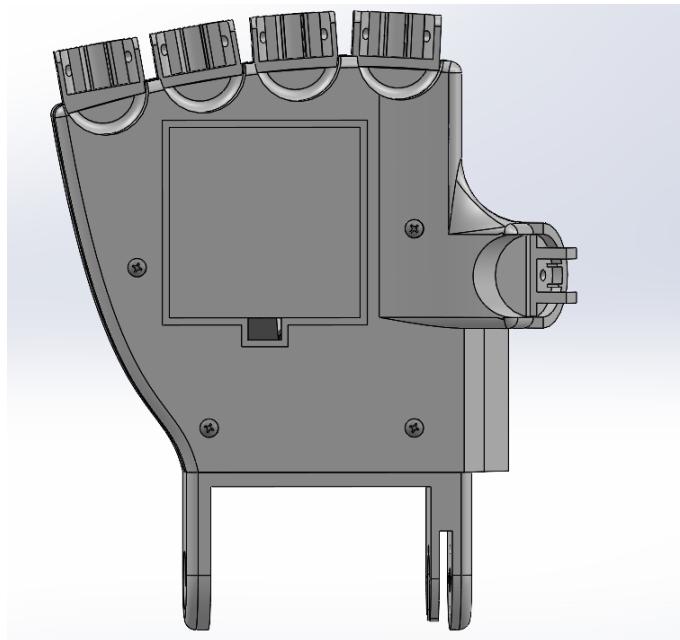
- Step 5: Thread the spider wire from the pinky servo through Hole A. Thread the two strands of spider wire from the ring and middle servo through Hole B. Thread the spider wire attached to the pointer servo through Hole C. Thread the spider wire attached to the thumb servo through Hole D. (Holes A, B, and C are on the palm lid. Hole D is on the palm bottom.)



- Step 6: Pull all strings tight through their respective holes while making sure that the strings lay in the dips of the spools.



- Step 7: Thread each string through its respective finger joint.
- Step 8: Fasten the palm lid to palm base with four provided #2-56 screws



Bottom palm assembly:

Step 1: Gather four 0-80 bolts and three nuts.

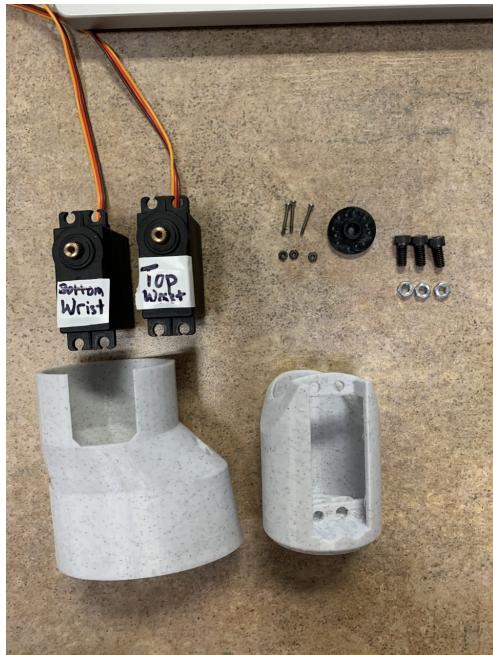
Step 2: Use one of the bolts to clean out the four small holes for the servo horn found on the bottom of the palm that attaches to the wrist.

Step 3: Place servo horn in the slot, with the protruding circle pointing inwards towards the palm.

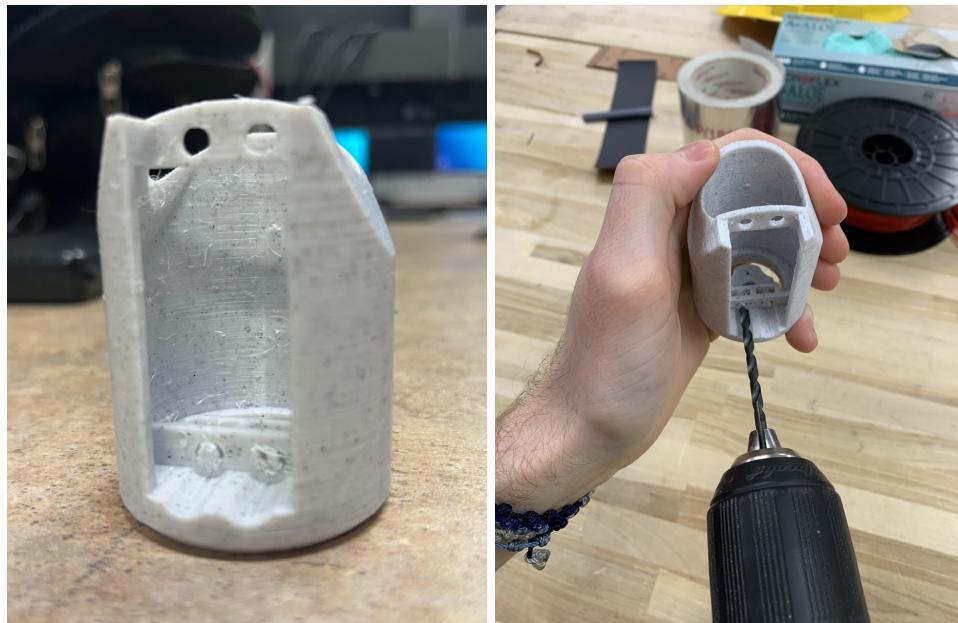
Step 4: Use one bolt to align the servo horn in the bottom hole of the bolt pattern. This bolt should be pointing outward from the palm.

Step 5: Put the remaining three bolts in their corresponding holes of the bolt pattern, facing inward toward the palm.

Wrist Assembly



Step 1: Take the wrist cylinder and clear support material from mounting holes and hex nut retainers. This is best done by using a drill to remove the bulk material, then using needle nose pliers and a sharp pick to remove the rest. Please be patient and careful doing this, as it may take a few minutes to complete.



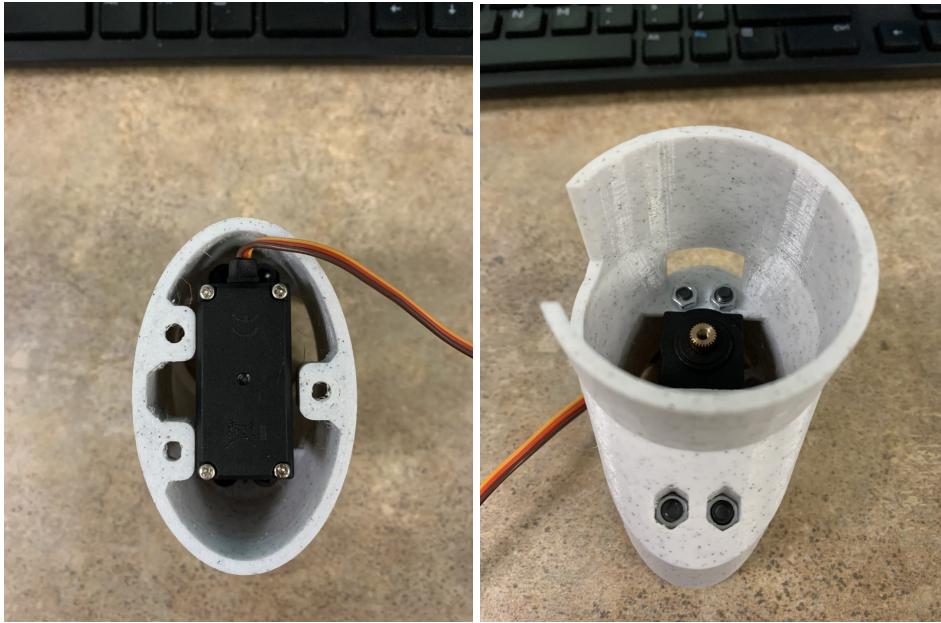
Step 2: Place hex nuts into the bolt housing at the bottom of the wrist housing. Note that these will be a very tight fit and may need assistance of a hammer and pin to firmly push down into the socket.

Step 3: Flip the wrist cylinder upside down and use three of the 0-80 bolts to secure the servo horn against the bottom of the cylinder, with the protruding circle facing outwards. Secure on the inside of the cylinder using the 0-80 nuts.

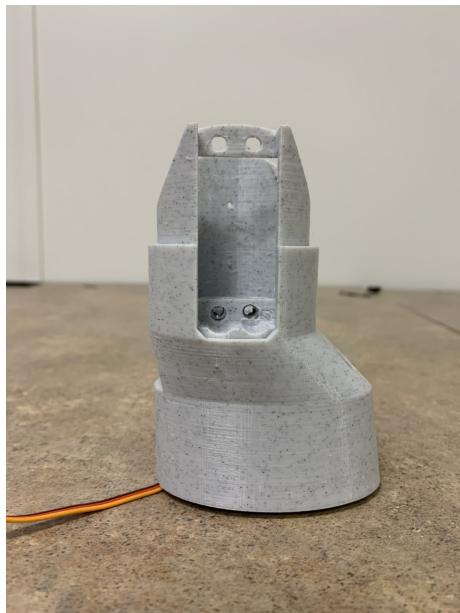


Step 4: To calibrate servo positioning properly, take each servo motor and turn it clockwise until you are unable to do so.

Step 5: Mount one MG996R servo to the bottom wrist housing by using four 8-32 bolts in the upward direction, with 8-32 nuts securing them. Note that the nuts should be placed as far as possible down into the hex cutouts first, before screwing the bolts upward to ensure firm connection. Additionally, the servo gear should be positioned at the center of the cylinder, if it's the wrong direction the top wrist mount won't be able to connect to it.



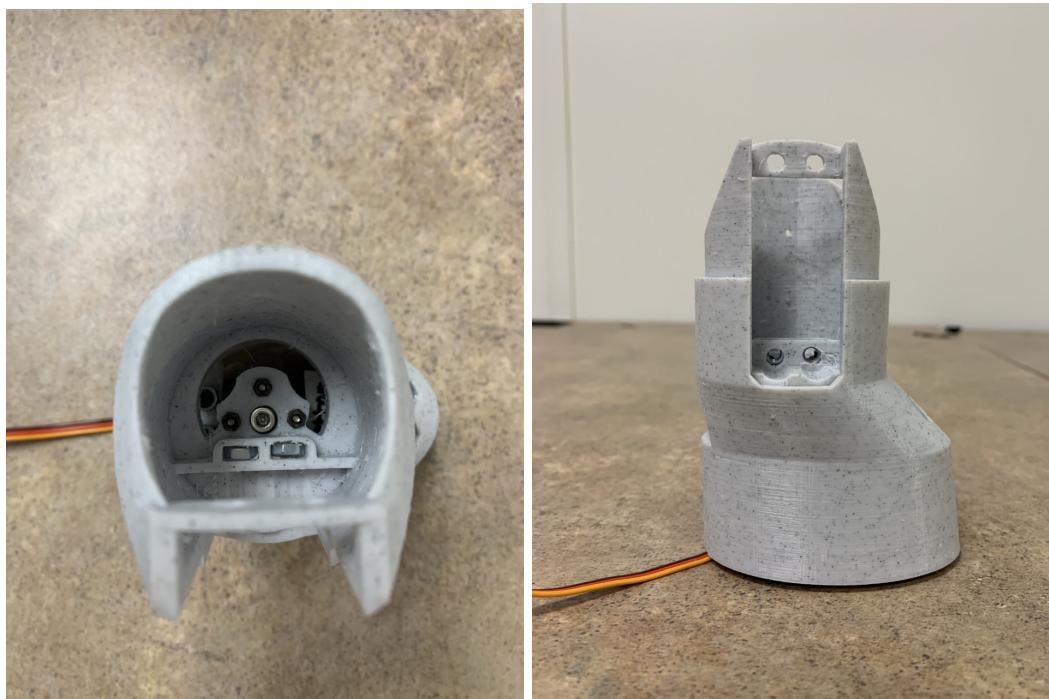
Step 6: Place the top wrist cylinder into the bottom wrist housing on top of the servo that was mounted in step 5. The horn on the bottom should attach to this servo with the rectangular cutouts on both the housing and cylinder aligning perfectly.



Step 7: Screw a M3 bolt into the middle of the bottom of the wrist cylinder until it is tight.



Step 8: Place two 8-32 nuts into the nut housing towards the bottom of the cylinder. Ensure nut holes are flush with the mount holes and avoid rotating the wrist until after step 8.



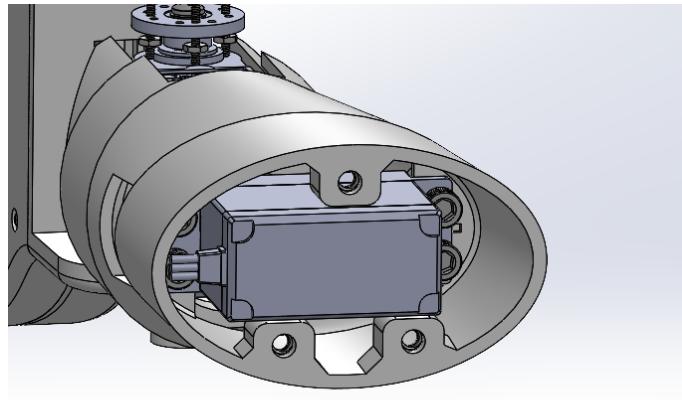
Step 9: Place the second MG996R servo into the rectangular cutout, with the motor's gear oriented towards the top. Ensure its wiring is properly fed through the wire management cutout. Screw the 8-32 bolts in until the servo is mounted securely.



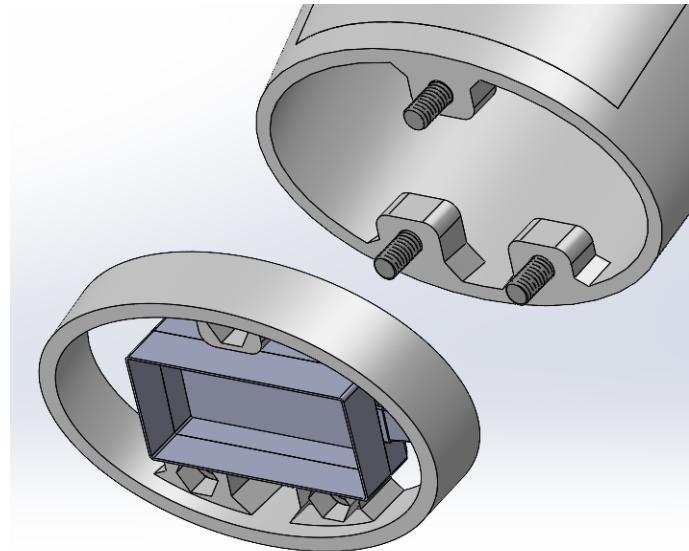
Forearm Assembly

Step 1: Remove excess stringy material from the main forearm using fingers or pliers. Ensure that the bolt holes are clear of debris.

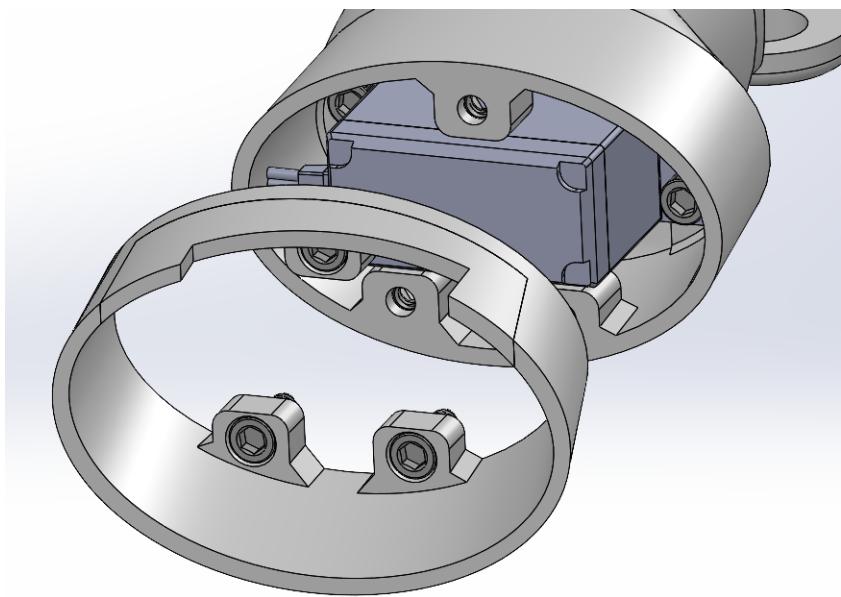
Step 2: Feed wiring through the wrist into the forearm cavity.



Step 3: Place nuts into their corresponding supports on the inside of the wrist.



Step 4: Thread bolts into their corresponding supports at the top of the forearm to connect wrist to forearm.



Wiring Assembly

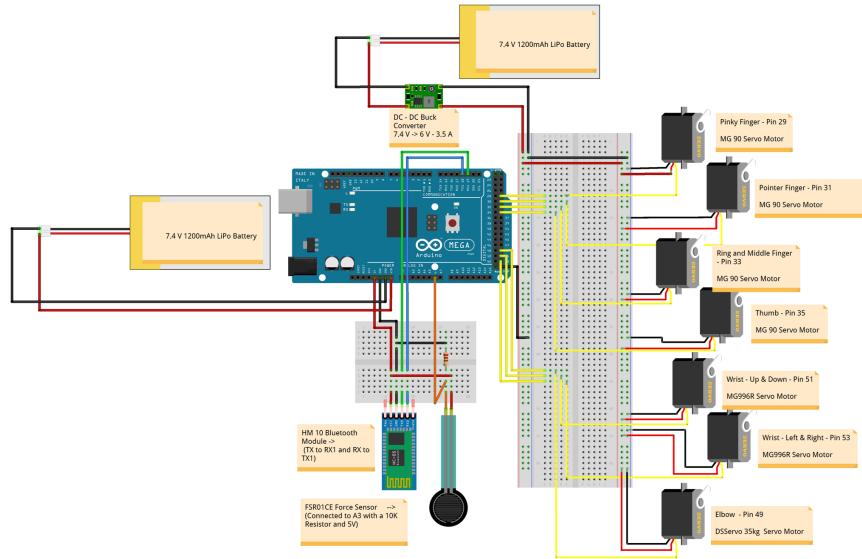
Step 1: Tape a LiPo battery under the Arduino mount

Step 2: Place the mount of the cutout for the serial port on the elbow connector

Step 3. Mount the Arduino to the mount

Step 4: Assemble the buck convert and optionally attach a toggle switch

Step 5: Connect components to mimic the wiring diagram. (Note: the force sensor is circular in the image but square in actuality)

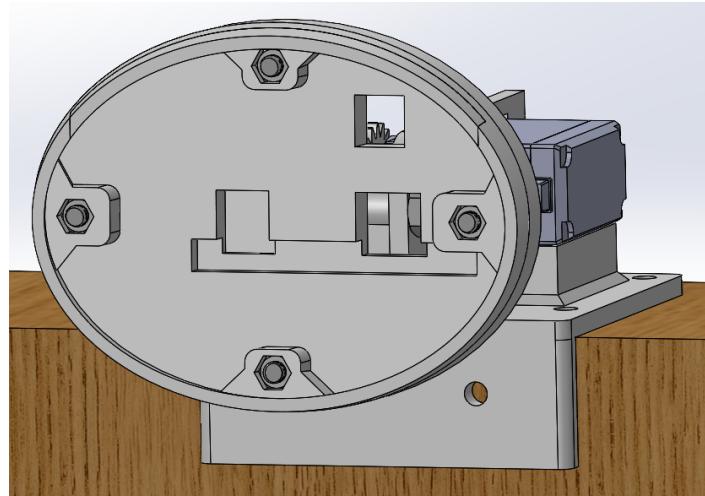


Step 6: Upload KSU2_Robot_Hand.ino to the arduino

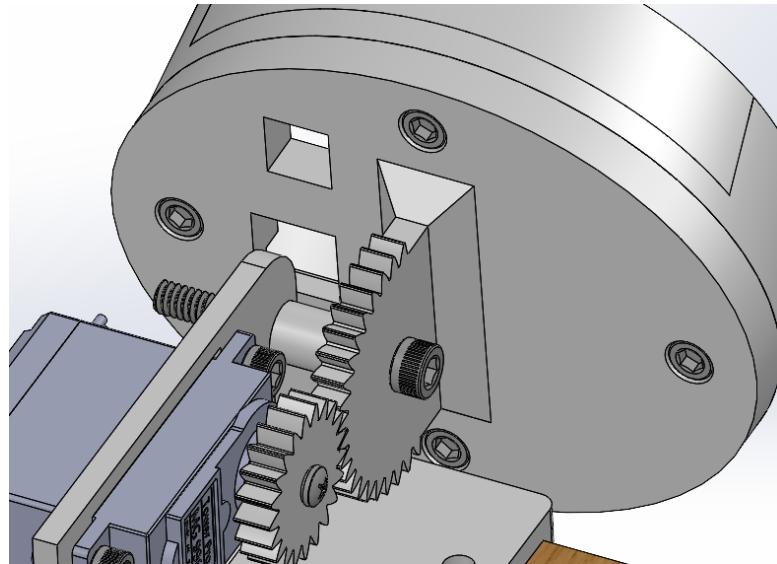
Step 7: Using the provided logic diagram, ensure all components are wired correctly

Elbow Assembly

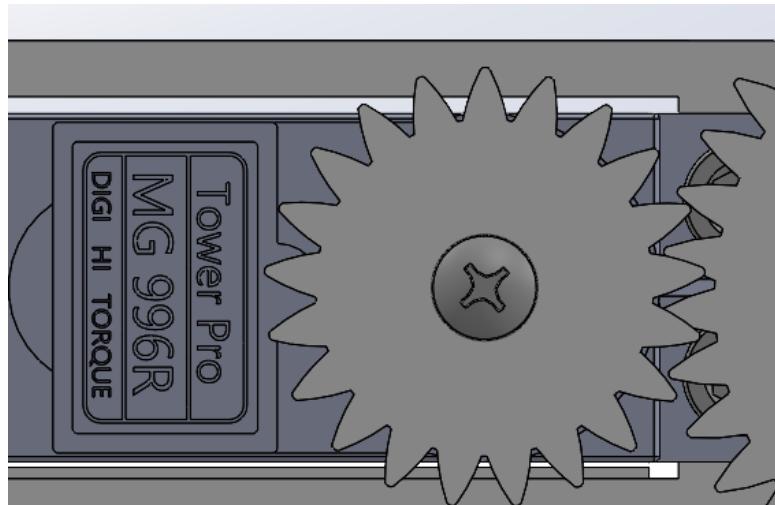
Step 1: Place nuts into their corresponding supports on the inside of the back of the forearm.



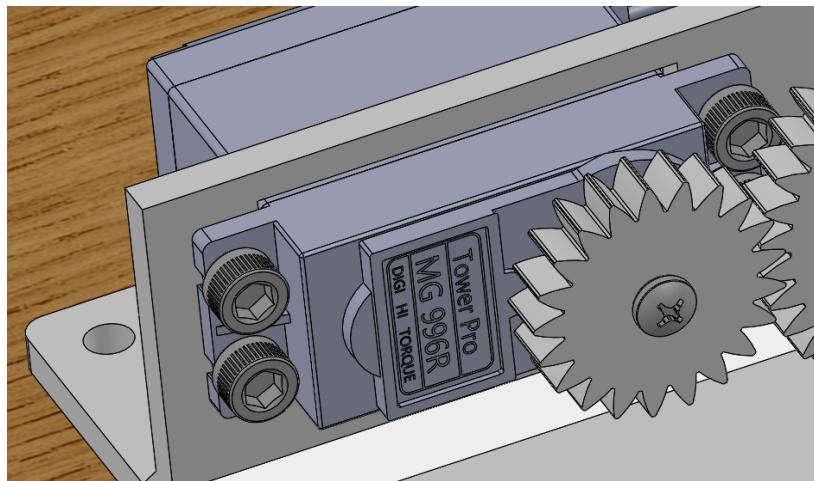
Step 2: Thread bolts through the endplate into the back of the forearm to attach the endplate to the forearm.



Step 3: Press smaller spur gear onto the DSServo and screw in using the provided DSServo flat screw. (note the MG996R servo is modeled here, but that's due to the two servos having similar mounting locations)



Step 4: Mount 35kg DSServo to the servo mount using 8-32 bolts and nuts.



Step 5: Fit a 10-24 bolt through the hole in the elbow endcap spur gear into the servo mount, and secure with a 10-24 nut.

