

## Simple Slider Hand Build Instructions

### Step 1: Parts

Print all major components from the Hardware/STLs/ folder

- Base.stl
- EndFixing\_Type1L.stl (left)
- EndFixing\_Type1R.stl (right)
- ServoCam.stl (print this with maximum possible fill, as it experiences significant forces when operating at high torque)

Purchase essential components:

- Dynamixel Mx28T
- High strength fishing line. 50Kg, 0.5mm is suitable.
- Rail and slider cars, any length above 175mm, with 25mm mounting hole pitch
- OpenCM9 and EXP485

Source:

- Electrical wiring for servomotor
- Electrical wiring for power board
- M3 Fasteners
  - 30mm with minimum 10mm shank x 4 (for end cap tendon guides)
  - 10mm with nuts x 8 (for securing fingers to right angle pieces)
  - 5mm (for securing right angles pieces into sliding cars)
  - 15mm x 2 (for securing end caps to rail)
  - 15 M3 heat set inserts
  - 10mm x 6 (for securing rail to base)
  - 25mm with minimum 10mm shank x1 (for centre tendon guide)
- M2.5 10mm with washer to fix servo cam to Mx28T metal servo horn
- M6 bolts if mounting to UR5 arm
- Mounting bolts for servomotor, these should come with the Mx28T

Fabricate:

- The metal parallel fingers
- The right angle bracket to mount the fingers to the cars. Note the small drill holes at the base of these

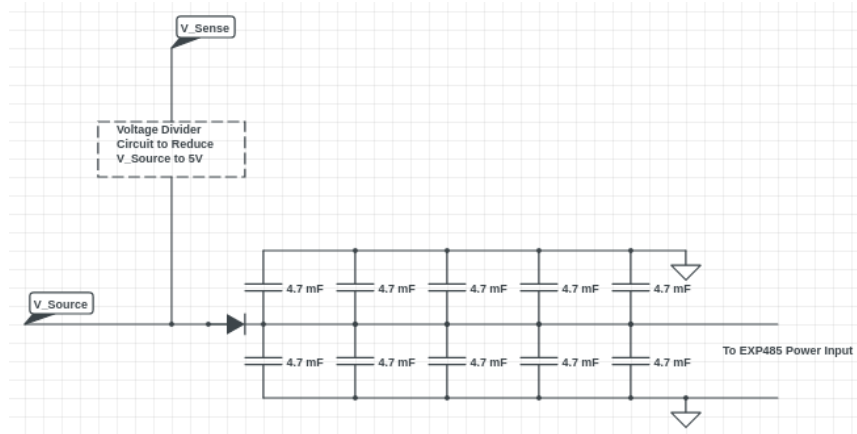
## Step 2: (Optional)

If you want to use the control box, with automatic open-on-power-loss (recommended) also print from Hardware/Controller/

- ControllerBase.stl

then

- add heat set inserts to controller base
- mount OpenCM9 and EXP485 into base
- build and mount capacitor board onto base



### Step 3: Assembly

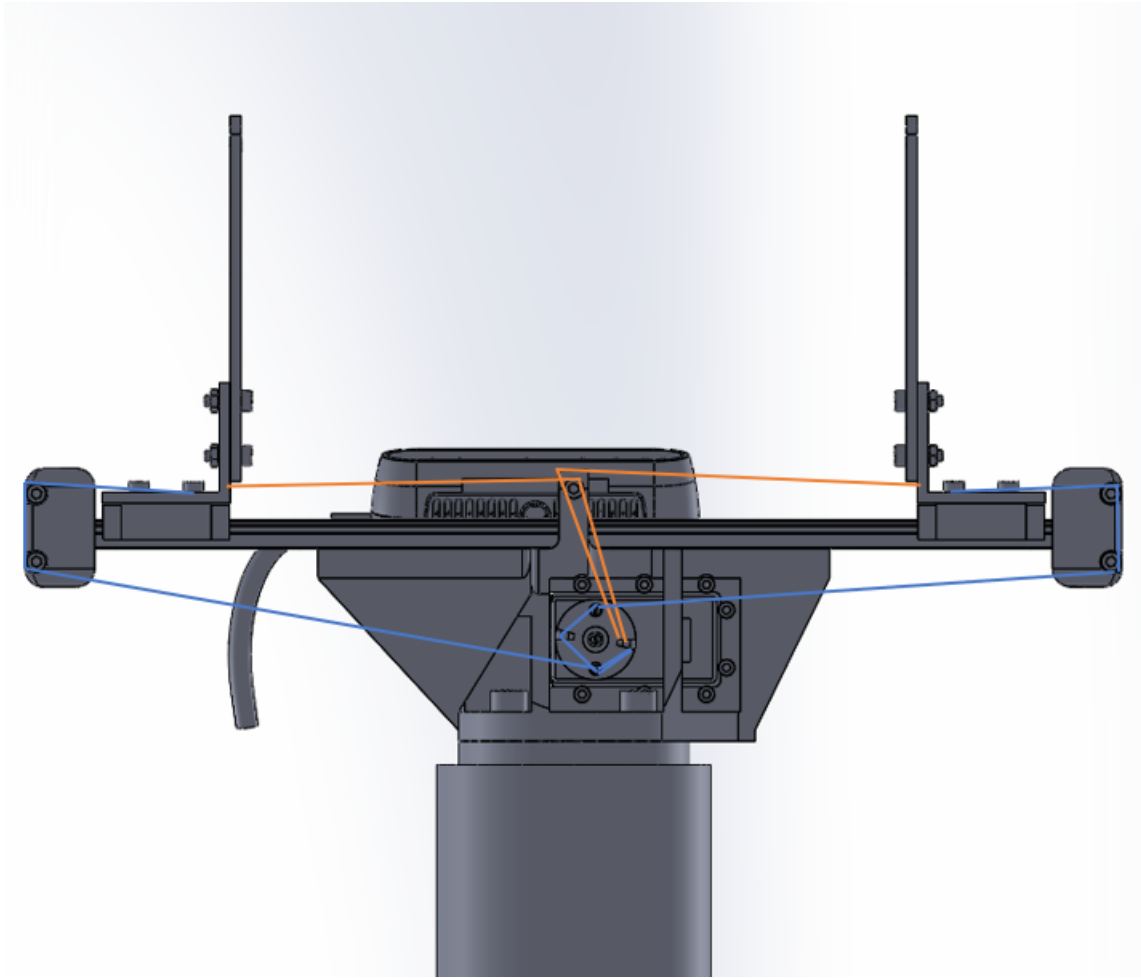
The hand is typically mounted with 3 m6 bolts but has space for a 4<sup>th</sup>. If you want to use a 4<sup>th</sup> bolt for extra rigidity, you need to insert that now. It is the one that sits directly beneath the servomotor.

1. Put heat set inserts into base using a soldering iron
2. Put heat set inserts into the centre tendon guide, and 3 into each end cap
3. Slide rail through centre tendon guide and bolt into base
4. Bolt right angle brackets and fingers onto each slider car
5. Bolt the D435 realsense camera into place
6. Slide dynamixel into hole in base, you may need to sand or file some parts of the base to fit it in
7. Bolt dynamixel into base on the front and back
8. Attach the servo cam to the metal servo horn
9. Attach the metal servo horn and cam onto the servomotor
10. Slide the cars onto the rail
11. Bolt the end caps onto the rail

All the components should now be attached and just the tendons are missing. To run the tendons:

1. Power up the servomotor and direct it to a nearly closed position using 'p100'
2. Note which way it turns, when you wrap the tendons around the cam, they must go in the direction that results in the hand being pulled closed when a lower p value is input
3. Tie the tendons through the small holes drilled in the right angle brackets and pass these around the centre tendon guide, then down to be wrapped around the servo cam.
4. Move the sliding cars all the way to the middle of the rail (fully closed)
5. Calculate how many wraps of the servo cam are required to cover the full rail distance (n turns)
6. Pass these through the notches in the servo cam, wrap them n times, and secure them by wrapping them underneath the washer holding the servo cam on (this should be slightly loose for now)
7. Now for the return tendons; we run these in the opposite way
8. Start by tying them underneath the washer and tighten this down as hard as possible without destroying the cam
9. Now take the return tendons, wrap them once around the cam (in the opposite direction to the closure tendons) and pass them through the notches in the cam
10. Run each return tendon out to one of the end cap tendon guides and pass it over both bolts in these
11. It should then go back to the outside of the angled bracket on each car
12. Loosen one of the bolts holding the bracket to the car, wrap the return tendon around this, pull it tight (the car should still be in the fully closed position, with the closure tendon tight), and tighten down the bolt.
13. Both tendons should now be attached, with a minimal amount of slack in the system. Make sure the bolts holding the tendons in place are fully tightened as they can easily slip.

Below is a diagram of the tendon routing, with the closure tendons in orange and return tendons in blue. In the shown configuration the return tendons will need to be able to extend, so require multiple wraps around the servo cam.



You will need to configure the calibration values in the `Software/GripperSoftware/GripperSoftware.ino` file once you have set up the tendons. It's recommended that you perform the calibration with a low torque value, as you can easily break the tendons or servo cam by driving it in the wrong direction or beyond the rail limits.