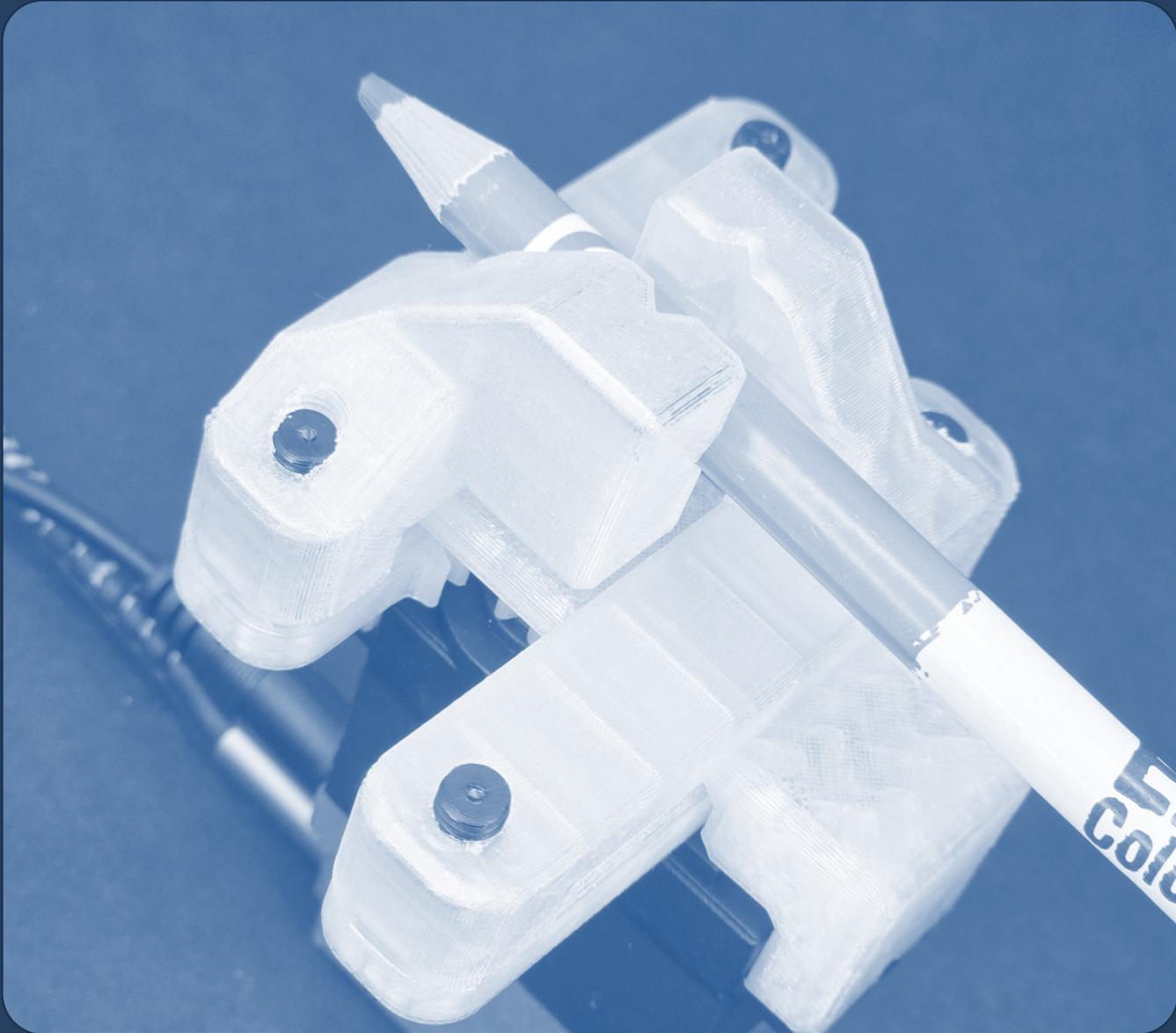


# SMARTSERVO

## ADAPTIVE GRIP: HELPING HAND KIT



# SMARTSERVO PROJECT

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**Hardware Requirement:** This guide requires **Smart Servo devices** to complete the projects and activities described. Smart Servos are available through the Smart Servo Store and authorized distributors.

### About the Smart Servo Project

The Smart Servo Project empowers inclusive innovation by providing accessible tools for creating assistive technologies and engaging STEM education. Our mission is to bridge technology and compassion through community-driven maker education.

Support our mission by purchasing Smart Servos and sharing our resources with your educational community.

#### Contact Information:

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Smart Servo Store: [WagnerLabs..Store](http://WagnerLabs..Store)

**Client: Aisha Williams, Age 19**

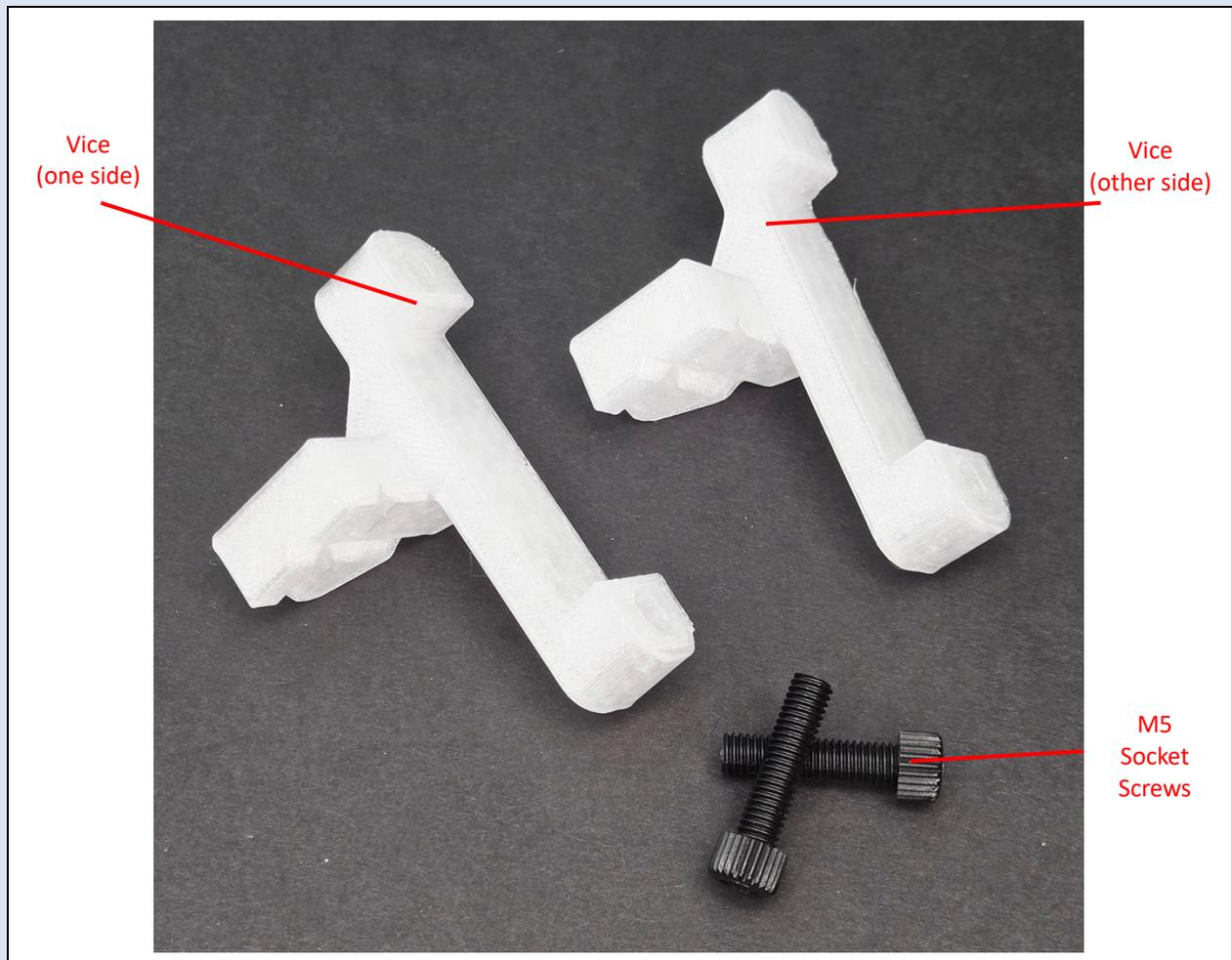
**About Me:** I'm a college art student majoring in ceramics and sculpture. I have spina bifida and use a wheelchair. While I have good upper body strength, my reach is limited, and I sometimes need to hold tools or materials in specific positions while working.

**My Challenge:** In my studio classes, I often need to hold paintbrushes, sculpting tools, or reference materials at specific angles while working on projects. Sometimes I need to keep something steady off to the side while using both hands for detailed work.

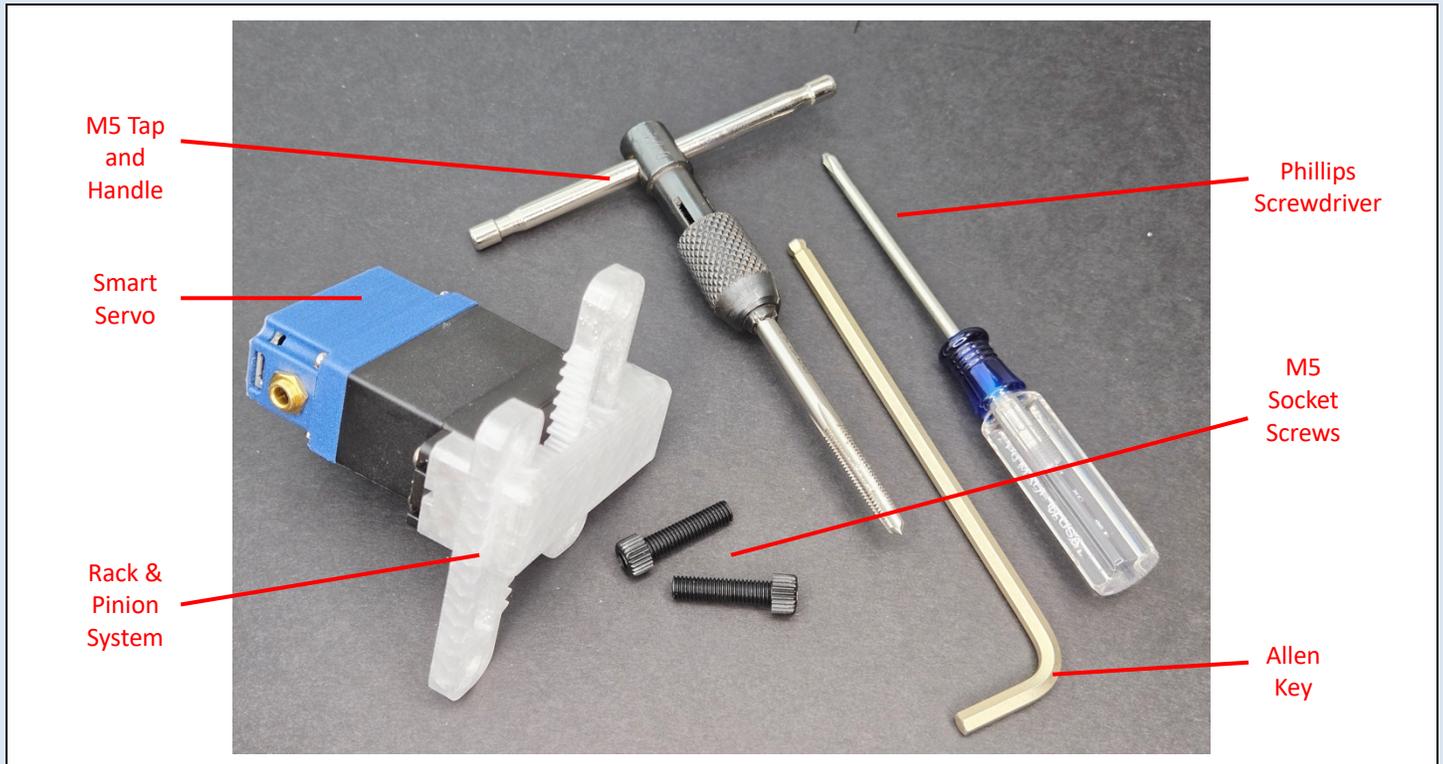
**Technical Need:** A flexible grabbing device that can hold various art supplies and tools securely without damaging them, positioned where I can easily reach and activate it when needed.

Let's now investigate our kit and see if we can get started on something that can assist Aisha.

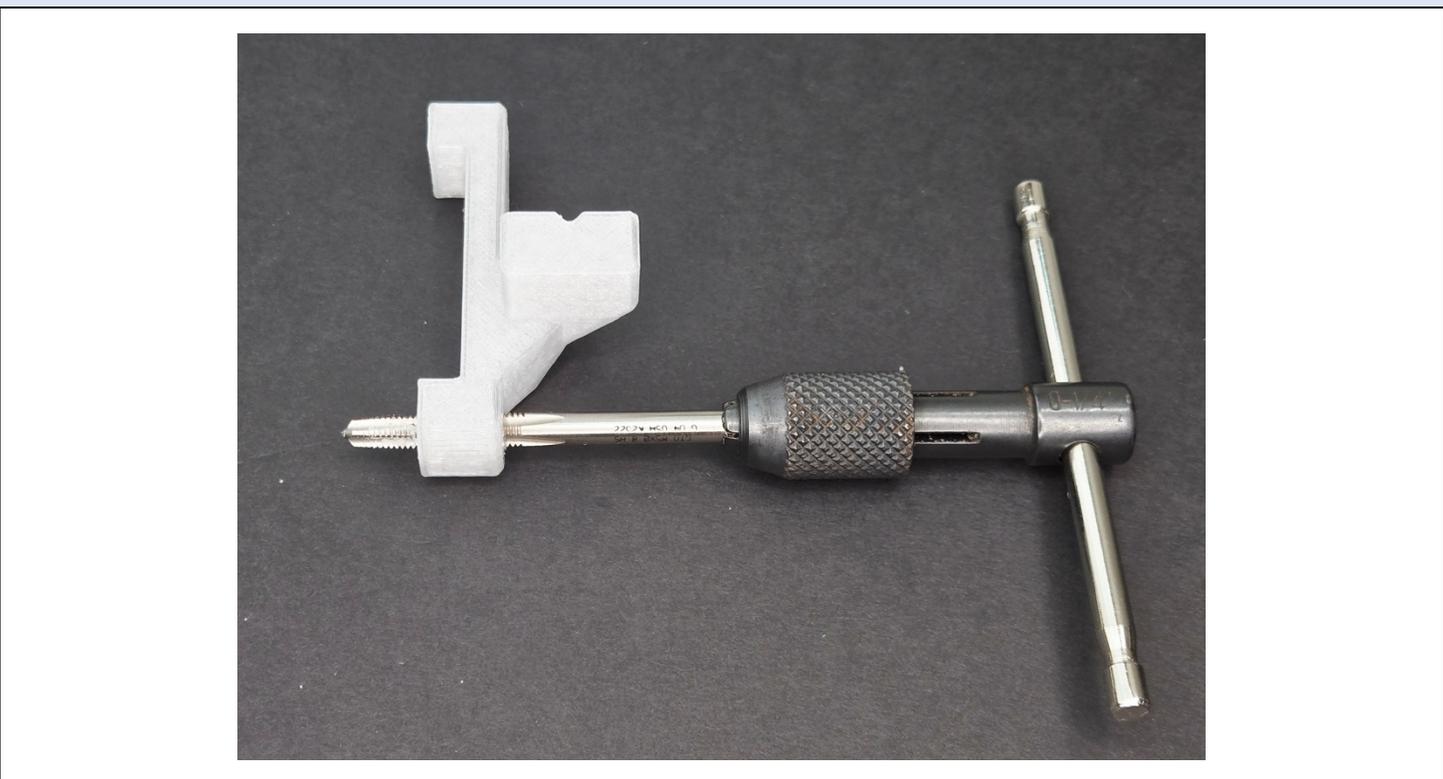
**STEP 1: Lay out all the components that are new in this kit.**



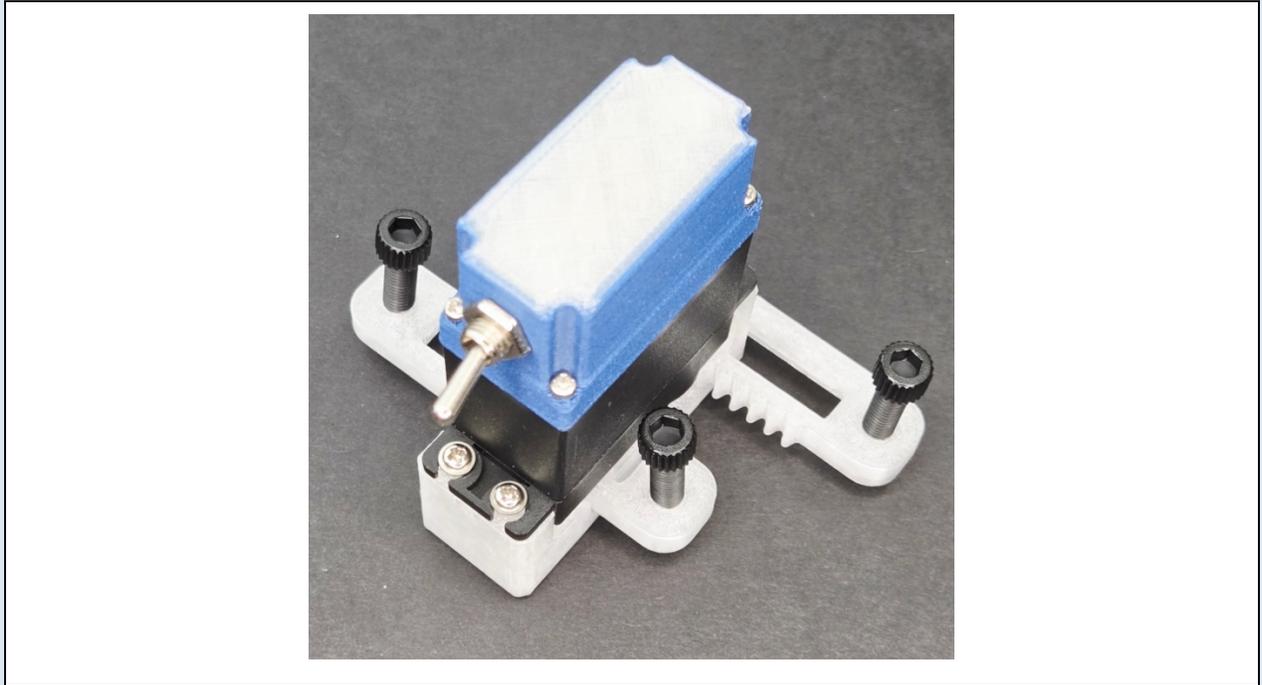
**STEP 2: Make sure you have these items from your previous kits.**



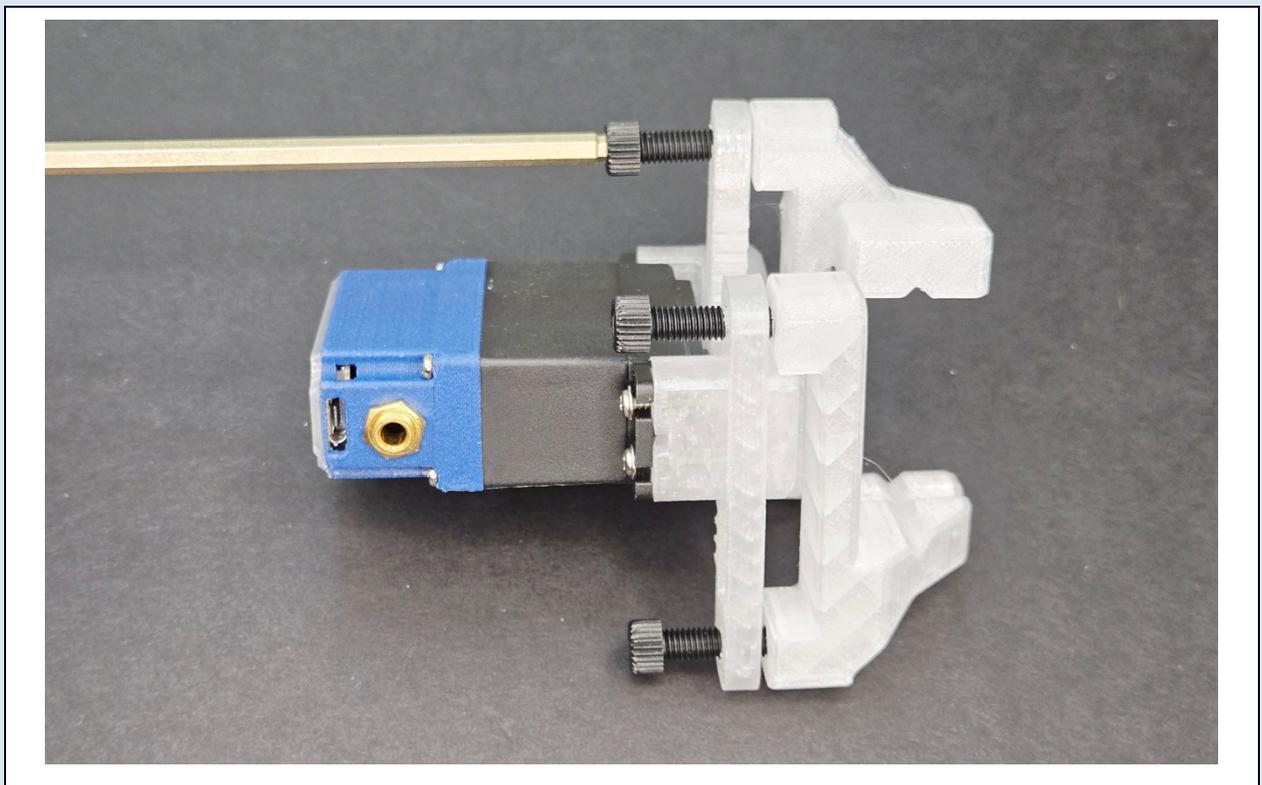
**STEP 3: Tap the 4.3mm holes with the 5mm Tap. There are four (4) total.**



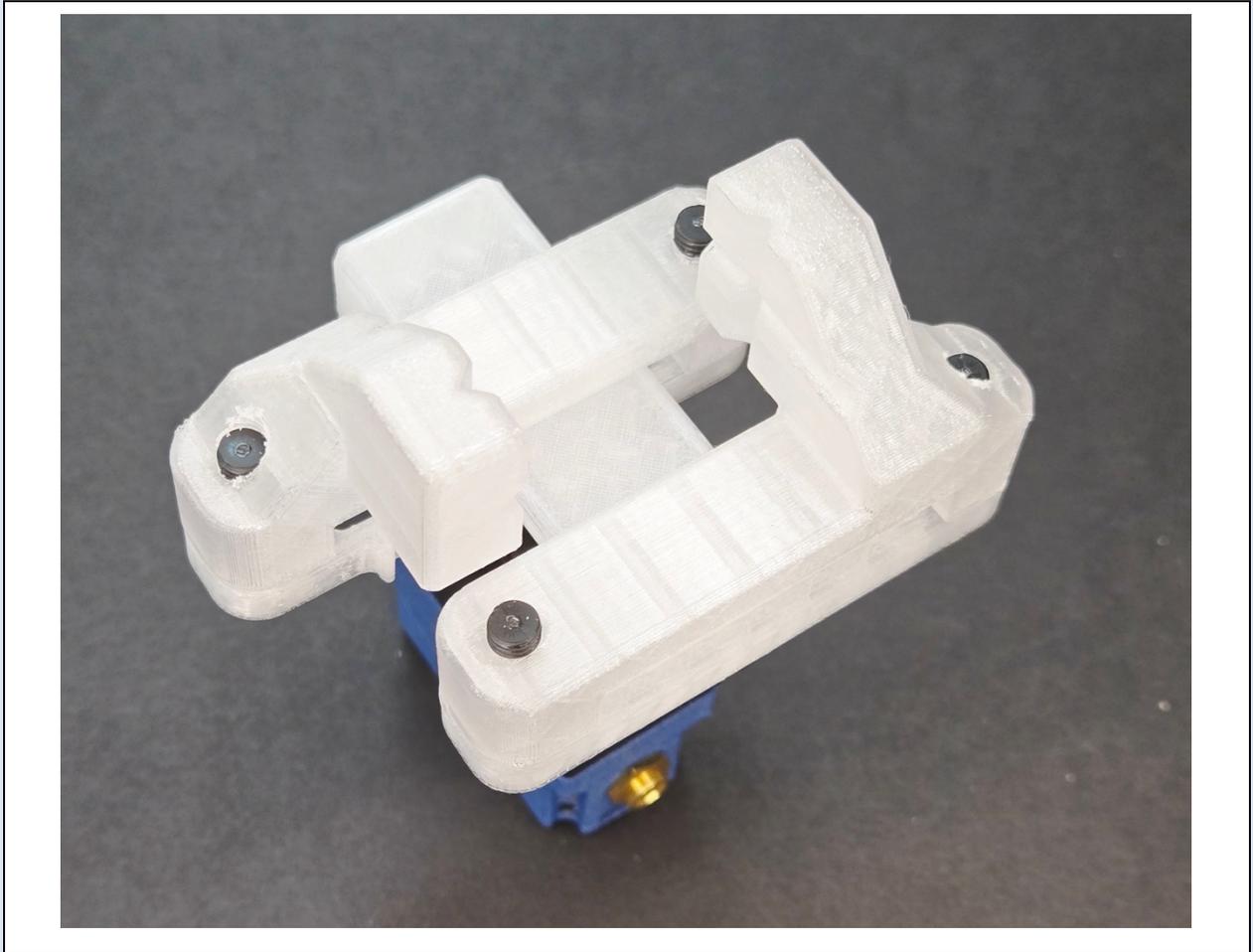
**STEP 4:** Use the Allen Key to screw the four M5 Socket Screws into the four holes in the Racks from the bottom as shown. Don't go all the way through yet.



**STEP 5:** Match the holes on the Vice sides as shown and screw all the way in.



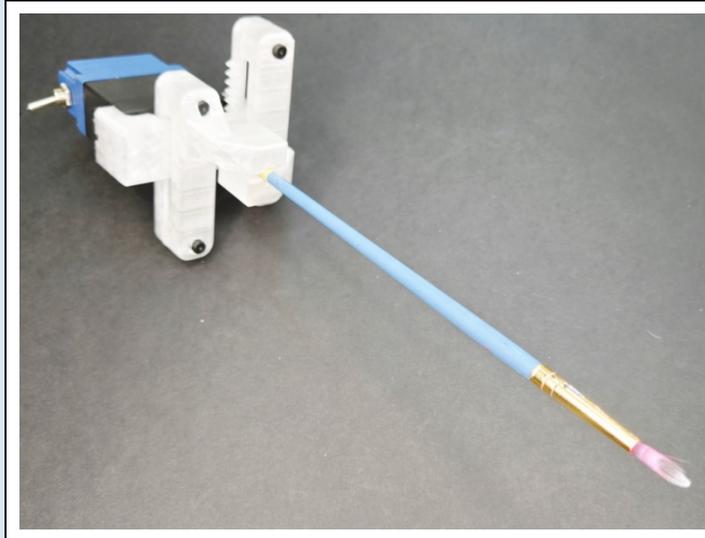
**STEP 6:** Double check that the Vice sides are the farthest apart when the Racks are at their farthest position.



**STEP 7:** Before you start adding objects to this new grip, make sure that you are working in the Smart Servo's code to find specifically what servo angles will place the Vice sides at the desired locations.

**Note:** If the Smart Servo is gripping too hard, it will make a hi-pitched squealing sound. Over an extended period, this could damage the Smart Servo. For the longevity of the Smart Servo, try to find the optimal gripping distance and add padding to ensure a firm grip.

**STEP 8: CONGRATULATIONS!** You've created an assistive grip device.



Re-read Aisha's request. What follow-up questions would you ask to make it better? Are there other changes you would consider making to the code? Do you have any suggestions?



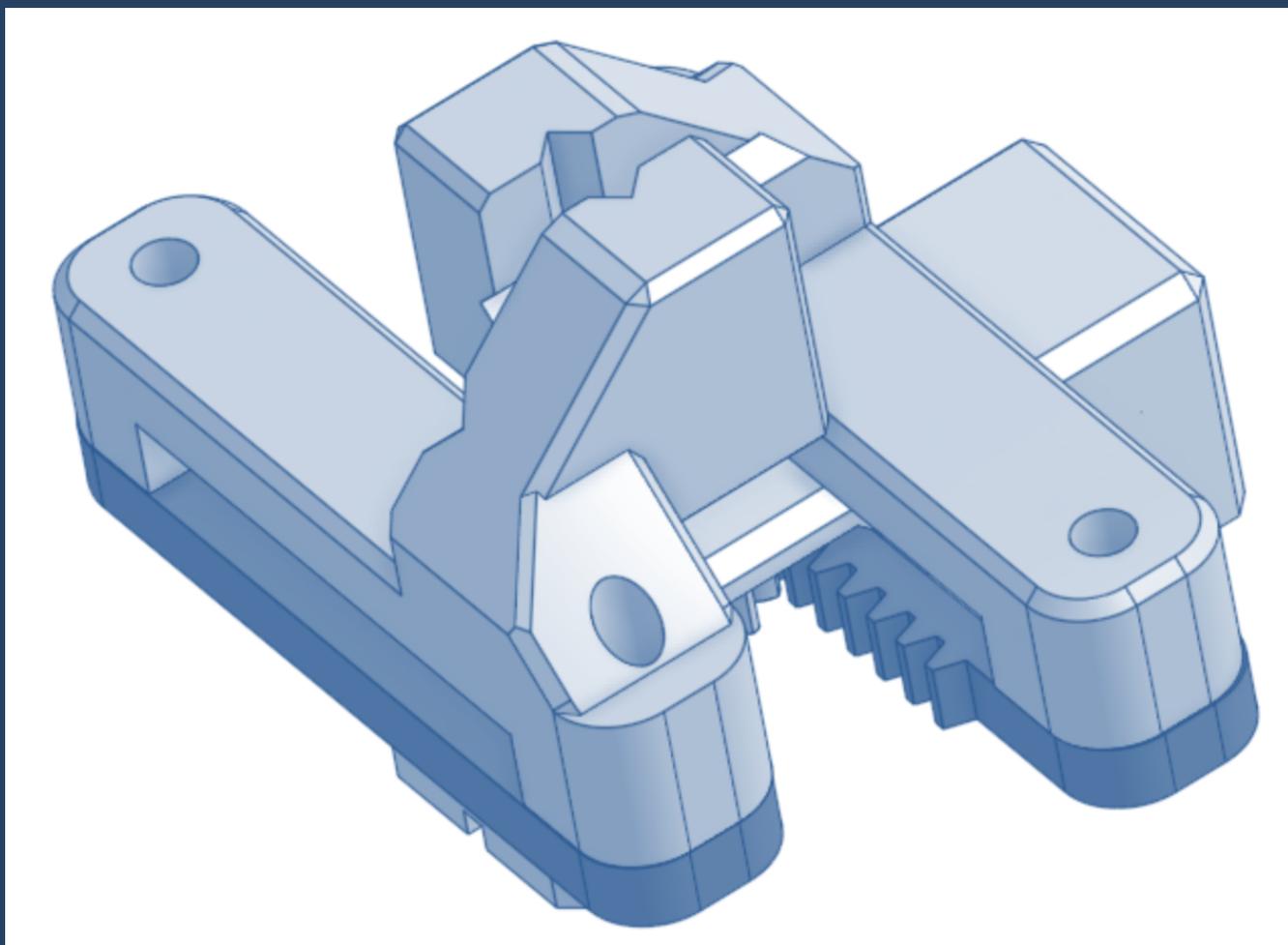
### REMINDER ABOUT CODING SNIPS

If you want to return your code to the original “factory setting”, just copy and paste from here: [tinyurl.com/SmartServoSrips](https://tinyurl.com/SmartServoSrips)



### 3D PRINTING FILES

If you're able to 3D Print, download the 3D parts used in this project here: [tinyurl.com/SS-STL-GRIP](https://tinyurl.com/SS-STL-GRIP)





## THE BIGGER PICTURE

### UNDERSTANDING END EFFECTORS IN YOUR ADAPTIVE GRIP SYSTEM

#### The Business End of Robots: What End Effectors Do

Your Smart Servo can position things precisely and move with controlled force - but without the grabber attachment, it can't actually interact with objects in Aisha's world. The grabber is what roboticists call an "end effector" - the specialized tool at the end of a robotic system that performs the task. Just as your hand is the end effector for your arm, the grabber is the end effector for your Smart Servo system.

This separation between positioning system and end effector is fundamental to robotics. A factory robotic arm might swap between dozens of different end effectors throughout the day - a welding torch, a gripper for moving parts, a spray nozzle for painting, a spinning buffer for polishing. The arm provides precise positioning, but the end effector determines what task gets accomplished.

#### Matching End Effectors to Tasks

Engineers must carefully match end effector design to specific task requirements. Your grabber uses compliant "fingers" that conform to irregular shapes and grip without crushing - perfect for Aisha's art supplies like paintbrushes and delicate tools. Different tasks require completely different designs.

In manufacturing, end effector variety is astounding. Vacuum suction cups lift smooth surfaces like glass. Magnetic grippers handle ferrous materials. Needle grippers pierce and lift fabric in automated sewing. Strawberry picking robots use gentle silicone fingers that cradle ripe berries without bruising.

#### From Simple Tools to Sophisticated Instruments

End effectors range from passive tools to highly sophisticated instruments. A hook mounted on a robotic arm is technically an end effector - just a very basic one. Your grabber is more sophisticated, using servo control and compliant design to adapt to different objects. Surgical robots use end effectors with multiple articulated joints, force sensors, cameras, and cutting tools all integrated into one system. Mars rovers carry end effectors including rock abrasion tools, spectrometers for chemical analysis, and scoops for collecting samples.

#### The Universal Gripper Challenge

Engineers dream of creating a truly universal gripper - one end effector handling any object as adaptively as a human hand. This remains one of robotics' greatest challenges. Human hands combine 27 bones, over 30 muscles, thousands of nerve endings, and a lifetime of learned control. Recent innovations like soft robotic grippers made from flexible materials or jamming grippers using balloons filled with granular material approach this goal.