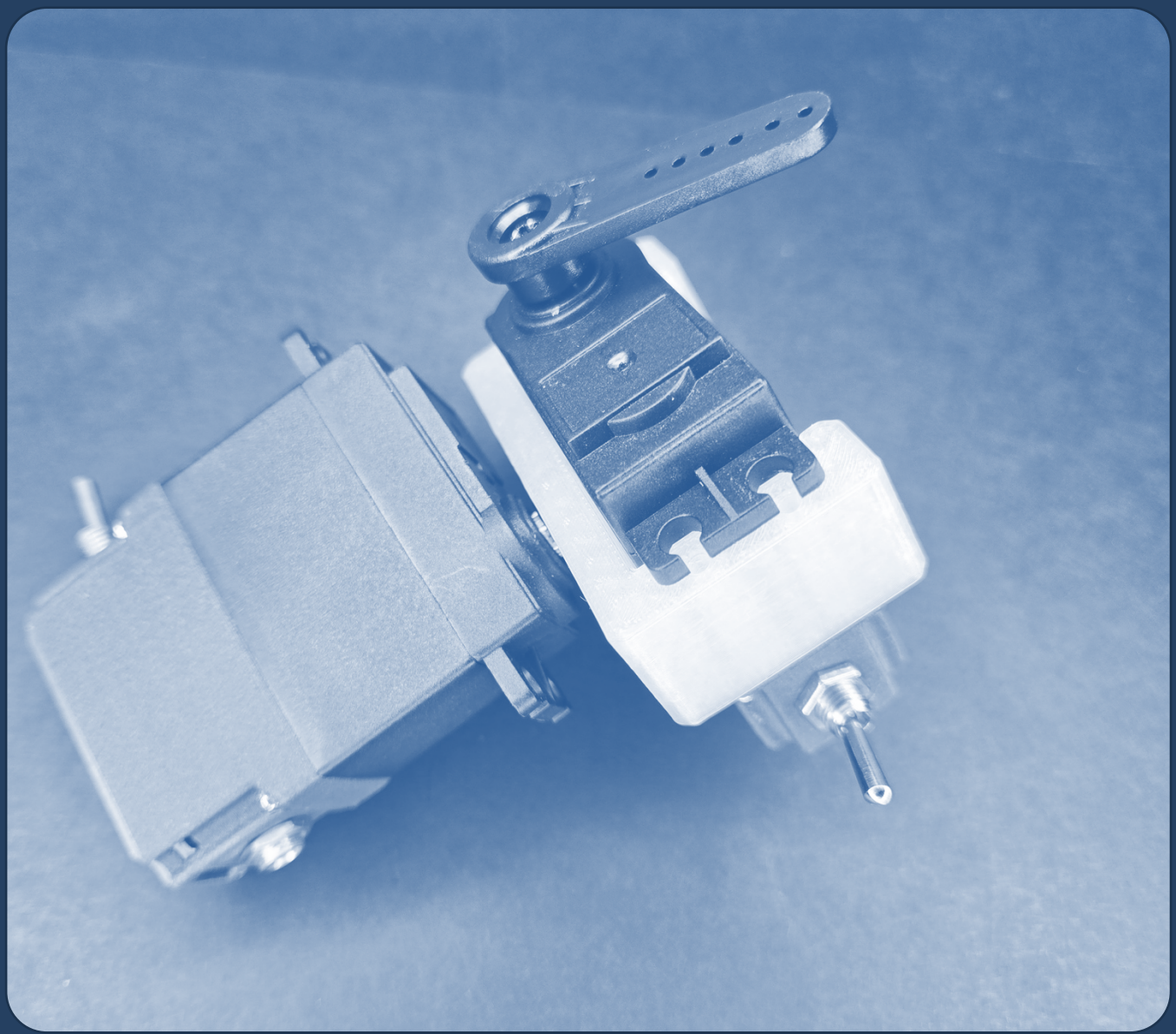
SMARTSERVO

PAN & TILT: PRECISION POSITIONING KIT



SMARTSERVO PROJECT

PAN & TILT: PRECISION POSITIONING KIT

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Commercial Use & Smart Servo Requirement

For commercial use, bulk educational licensing, or use outside of traditional educational settings, please contact Wagner Labs LLC.

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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Website: **WagnerLabs.net/SmartServo**
Smart Servo Store: **WagnerLabs.Store**

Client: Thomas Anderson, Age 52

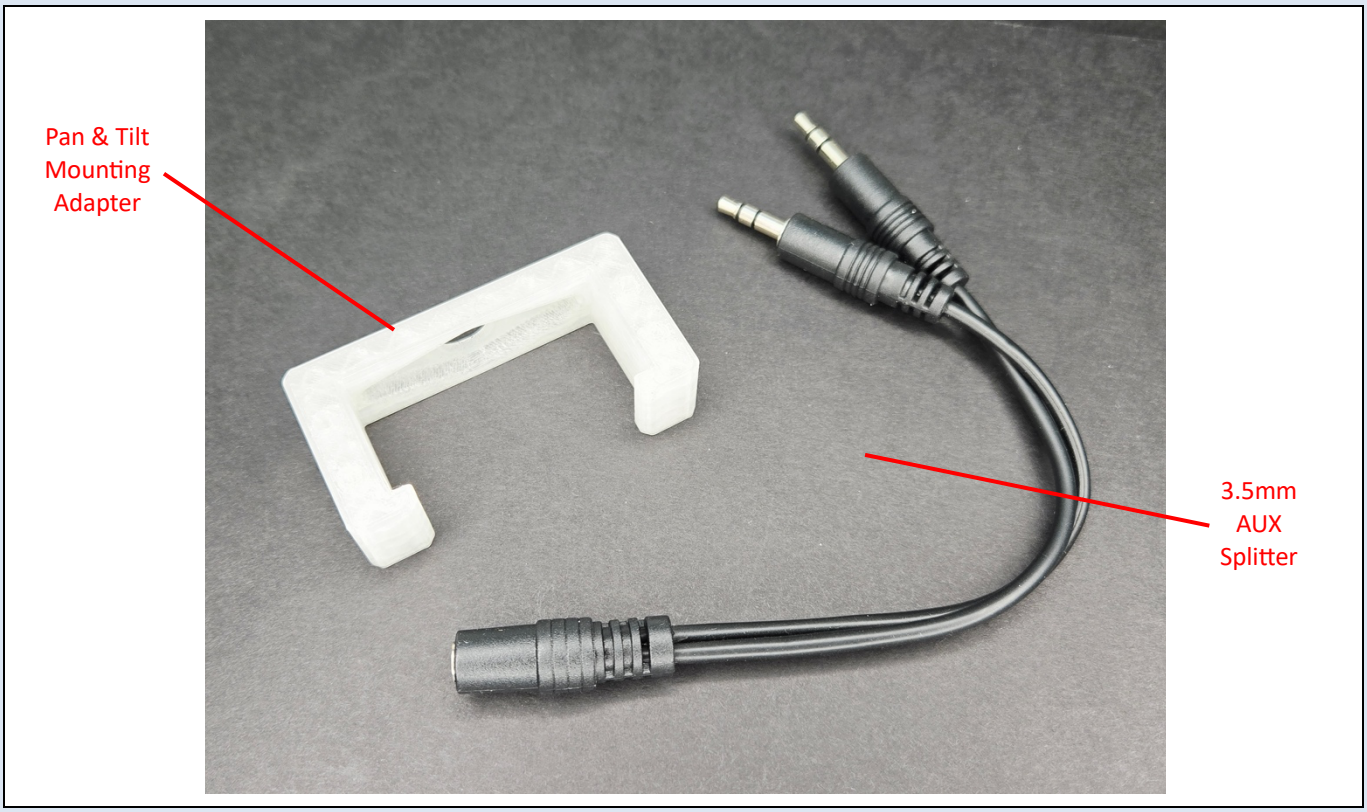
About Me: I'm a photographer and art teacher who recently developed essential tremor, which causes involuntary shaking in my hands. I'm passionate about teaching photography to students with disabilities at our local community college.

My Challenge: I can no longer make fine adjustments to camera positions or easel angles during instruction. My hand tremors make it difficult to demonstrate precise positioning techniques, which is essential for teaching composition and framing.

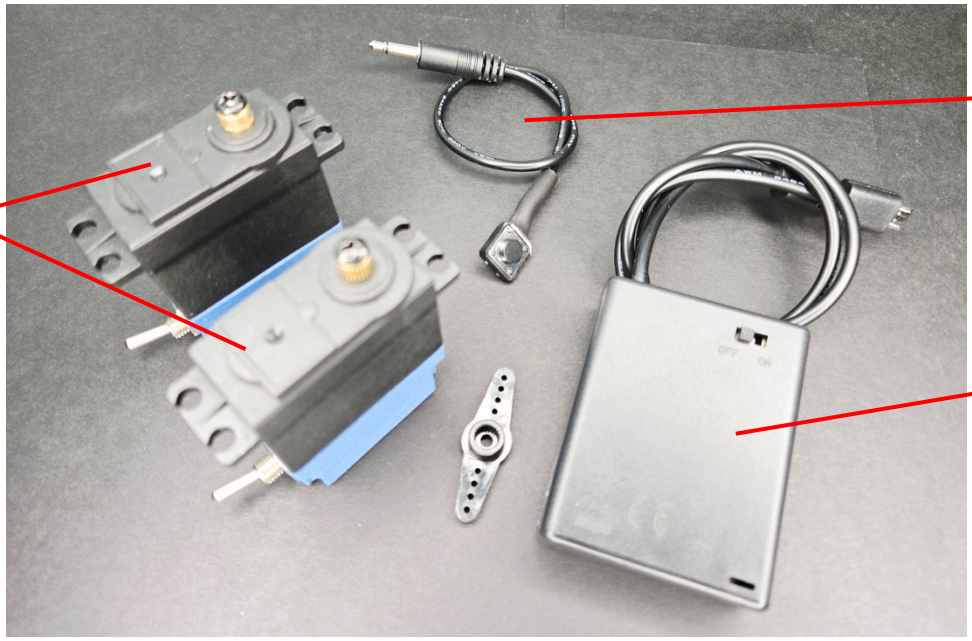
Technical Need: A smooth, controllable pan and tilt system that can position cameras, easels, or other equipment with precision, allowing me to demonstrate proper positioning techniques without hand tremor interference.

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

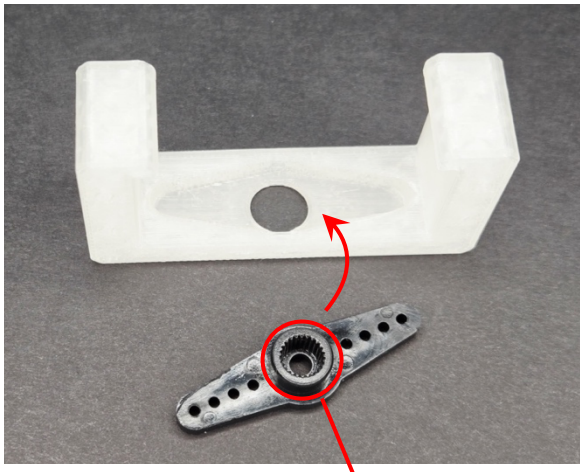
STEP 1: Lay out all the components that are new in this kit.

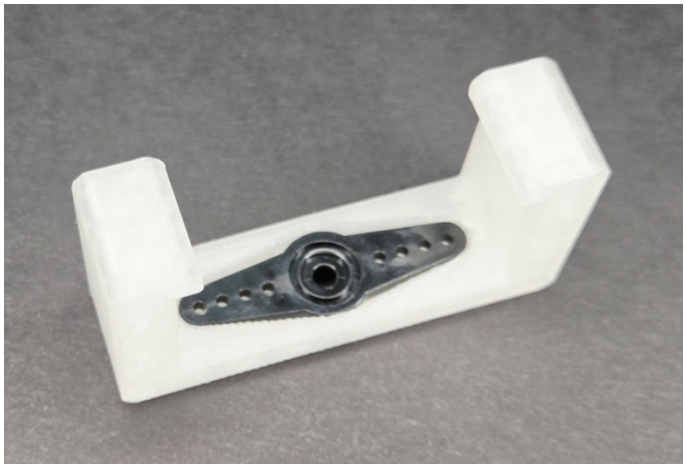


STEP 2: Make sure you have these items from your previous kits.

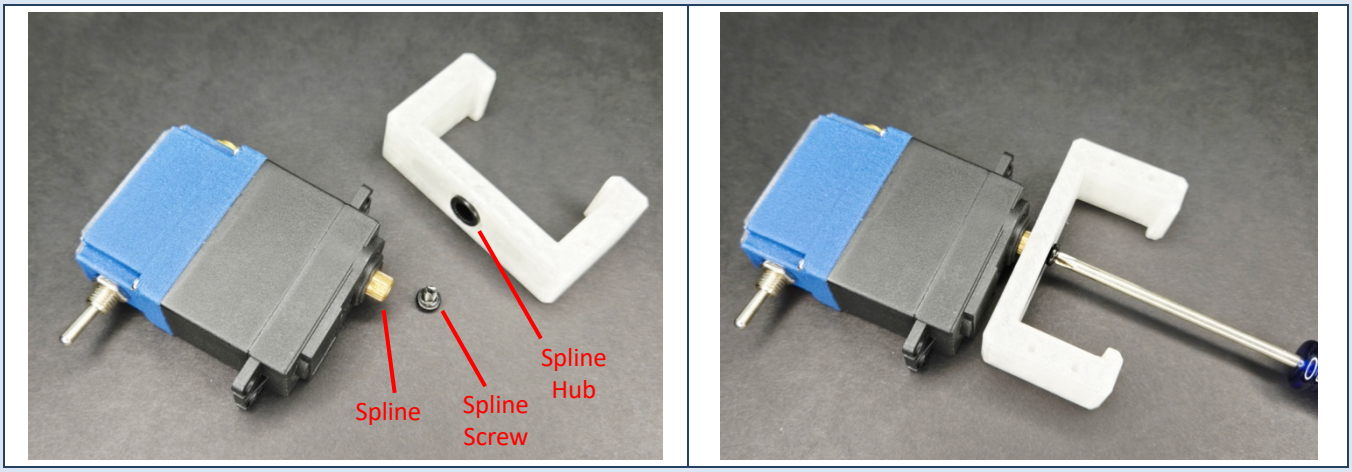


STEP 3: Insert the Two Horn Servo Horn into the Pan & Tilt Mounting Adapter. Make sure that the Splint Hub on the Horn fits into the hole on the Adapter.

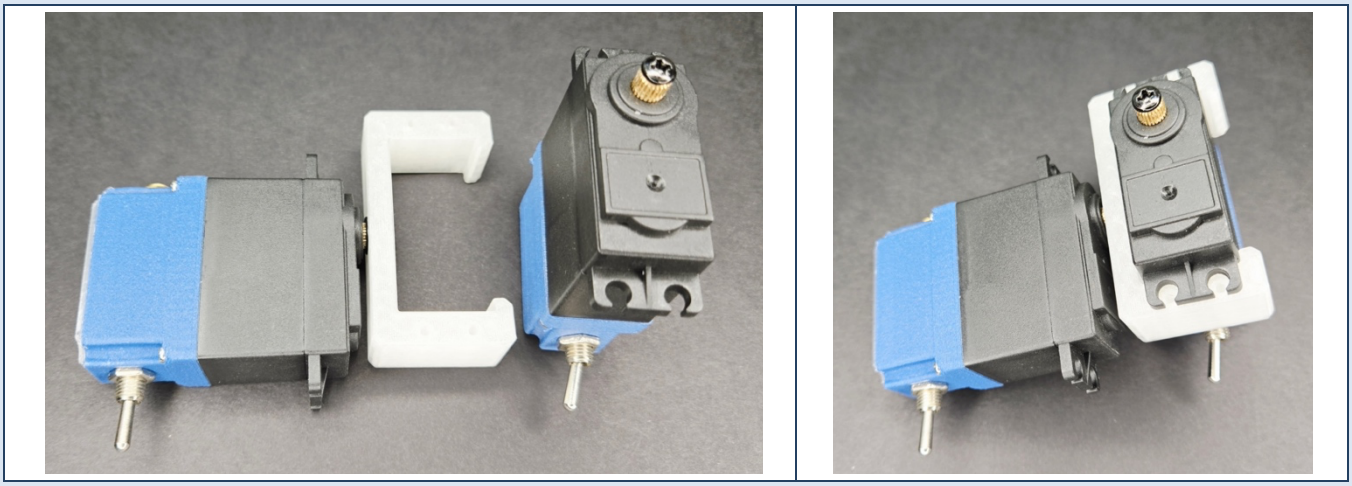




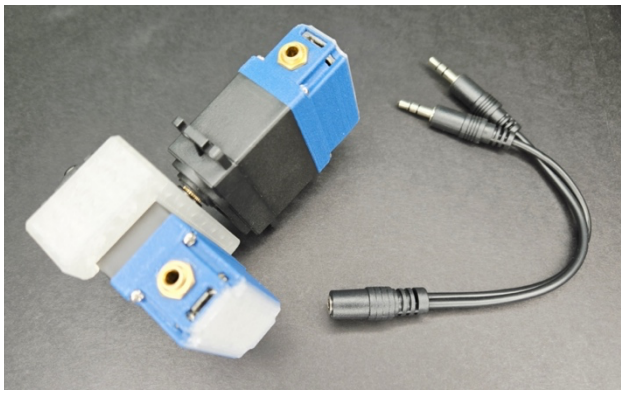
STEP 4: Remove the M3 Spline Screw from one of the Servos, align the Spline Hub on the Servo Horn with the Spline on the Smart Servo, and secure tightly with the Spline Screw.

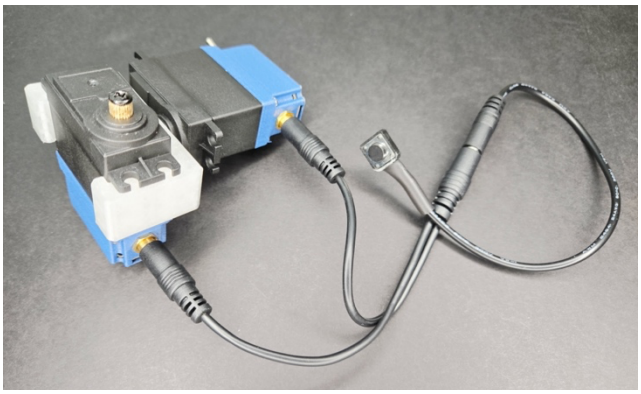


STEP 5: Connect the second Smart Servo to the Pan & Tilt Mounting Adapter. This is a compliant part similar to the LocLine Bracket in Kit 2 so there will be some bending as the second Smart Servo snaps securely into place.

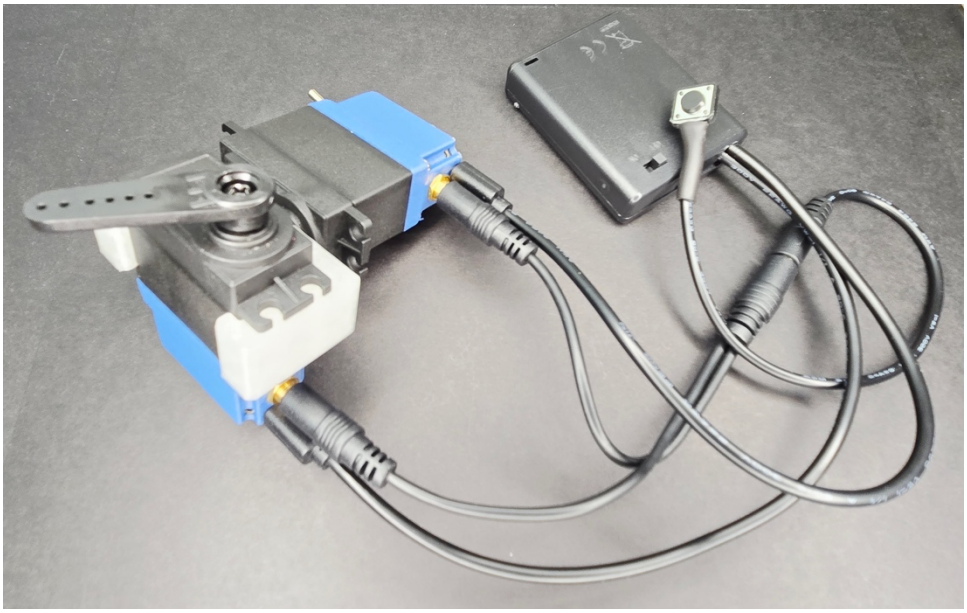


STEP 6: Connect the 3.5mm AUX Splitter to each of the 3.5mm Jacks on the Smart Servos and add the Test Button. This will allow one button to initiate two Smart Servos at the same time with a single button press.





STEP 7: Connect the Dual Battery Pack to each Smart Servo.



STEP 8: We now have a 2-axis system where one Smart Servo can rotate in one plane (Pan), while the other Smart Servo can rotate in a perpendicular plane (Tilt). Let's use some of the parts from previous kits to mount our Pan & Tilt mechanism and consider how we can re-code each Smart Servo to work together.

CONGRATULATIONS!

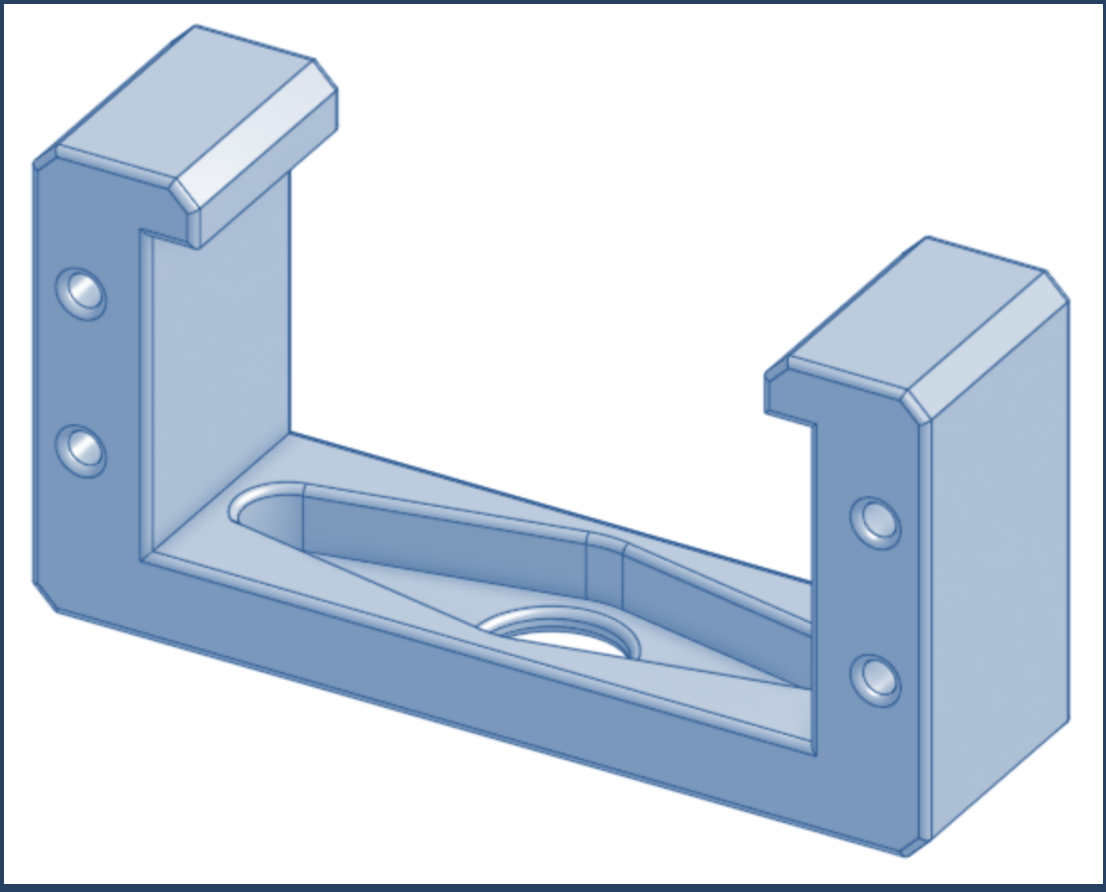
You just built a two-axis pan and tilt positioning system. Next, we'll want to consider what needs to be done next to better assist Thomas. Read his profile again and think about his teaching needs. What follow-up questions would you ask him about the types of equipment he positions most often in his photography classes? How might smooth, tremor-free control change what he can demonstrate to his students?

REMINDER ABOUT CODING SNIPS

If you want to return your code to the original “factory setting”, just copy and paste from here: tinyurl.com/SmartServoSnips

3D PRINTING FILES

If you’re able to 3D Print, download the 3D parts used in this project here:
tinyurl.com/SS-STL-PANTILT



THE BIGGER PICTURE

UNDERSTANDING MULTI-AXIS CONTROL IN YOUR PAN & TILT SYSTEM

Combining Movements for Complete Control

Your pan and tilt system uses two servos working together to point a camera or easel in any direction. One servo handles pan (horizontal rotation, like shaking your head "no"), while the other controls tilt (vertical rotation, like nodding "yes"). Separately, each servo can only move in one dimension. Together, they provide complete directional control—you can point at any position in space around you.

The power of multi-axis systems comes from their independence—you can adjust pan without affecting tilt, and vice versa. The perpendicular axes make positioning intuitive: move horizontally until aligned, then move vertically until aimed correctly.

Pan and Tilt Systems in the Real World

Pan-tilt mechanisms appear everywhere precise directional control matters. Security cameras use motorized pan-tilt mounts to scan areas automatically. Broadcast television cameras track fast-moving sports action smoothly. Satellite dishes on ships continuously adjust to maintain signal lock as the vessel rocks and turns, compensated in real-time using gyroscopes and accelerometers.

Astronomical telescopes represent some of the most precise pan-tilt systems ever built, tracking objects as Earth rotates and making thousands of tiny corrections per second to counteract atmospheric distortion.

From Two Axes to Many

Your two-axis system provides excellent directional control, but some applications need more. Industrial robot arms typically use six axes to position and orient their end effectors anywhere in 3D space. Camera gimbals add a third axis (roll) to keep footage level. Surgical robots might have seven or more degrees of freedom to reach around obstacles inside the body.

Each additional axis adds capability but also complexity. Two axes require coordinating two motors; six axes require coordinating six motors simultaneously. Engineers must balance capability against increased cost, weight, and control difficulty.

Stability and Precision

Thomas needs the pan-tilt system because his essential tremor prevents steady manual positioning. This highlights a key advantage of motorized multi-axis systems: once positioned, motors hold position with rock-solid stability that human hands cannot match. Camera stabilization systems use motorized gimbals with sensors to detect unwanted movement and instantly compensate, keeping footage smooth even when running.

This principle appears in microscope positioning systems for surgery, precision measurement tools in manufacturing, and smartphone cameras that counteract hand shake. Professional systems make complex multi-axis control feel natural and intuitive, hiding sophisticated coordination happening behind the scenes.