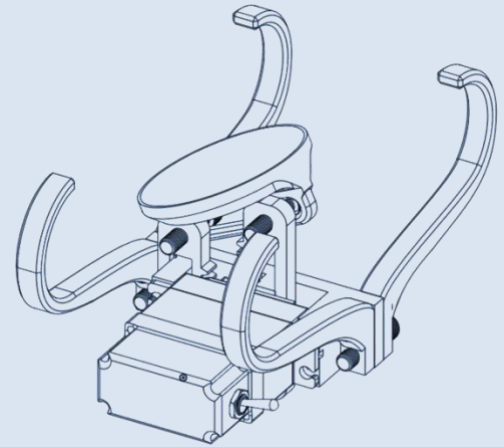


# SMART SERVO GUIDES: BOCCE BALL TILTER

The Bocce Ball Tilter attaches to the Adapted Bocce Ball Ramp created by *All Abilities Welcome* which was developed to expand this Special Olympics event to include students with physical disabilities.

This guide will cover the basics of preparations and assembly necessary for follow up testing and improvement to design and application.

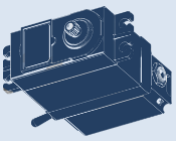


## PART 1a: Preparing - 3D Printed Materials

(Note: The Bocce Ball Tilter was designed, assembled, and tested using PETG filament with a 15% Gyroid infill. This may be important since there needs to be some compliance (bend) in the hooks to attach to the Adapted Bocce Ramp)

The following parts will need to be printed on a 3D Printer.

Cup		Approx. 12 g of Print Material Each	Print 1 For Each Project	<a href="#">Link to STL File</a>
Hook A TAP		Approx. 8.5 g of Print Material Each	Print 2 For Each Project	<a href="#">Link to STL File</a>
Hook B HEAD		Approx. 7 g of Print Material Each	Print 2 For Each Project	<a href="#">Link to STL File</a>
Rack		Approx. 5.5 g of Print Material Each	Print 2 For Each Project	<a href="#">Link to STL File</a>
Gear 12T		Approx. 0.8 g of Print Material Each	Print 1 For Each Project	<a href="#">Link to STL File</a>
Cover		Approx. 8.3 g of Print Material Each	Print 1 For Each Project	<a href="#">Link to STL File</a>



# SMART SERVO GUIDES: BOCCE BALL TILTER

## PART 1b: Preparing - Ordered Material

The following will need to be purchased for each project. (There will likely be spare material.)

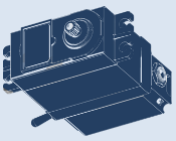
<p>Basic Smart Servo Kit</p>		<p>Will need Smart Servo and mounting screws</p>	<p><a href="#">Smart Servo Order Link</a></p>	<p>\$75</p>
<p>Machine Screws M5</p>		<p>Will need 6 from the pack of 100</p>	<p><a href="#">Nylon Plastic Socket Head Screw M5 x 0.8 mm Thread, 20 mm Long</a></p>	<p>\$18 (\$1)</p>

## PART 1c: Preparing – Recommended Tools\*

It is recommended to have the following tools available

<p>M5 Tap</p>		<p>Used to create M5 x 0.8 threads in 3D printed parts.</p>	<p><a href="#">Amazon Order Link</a></p>	<p>\$9</p>
<p>Tap Handle</p>		<p>Provides leverages for M5 Tap when it carves new threads.</p>	<p><a href="#">Amazon Order Link</a></p>	<p>\$9</p>
<p>Allen Wrench 4mm</p>		<p>Provides leverage when tightening M5 machine screws</p>	<p><a href="#">McMaster Order Link</a></p>	<p>\$2</p>
<p>Phillips Screwdriver #1</p>		<p>Useful for mounting screws and</p>	<p><a href="#">Amazon Order Link</a></p>	<p>\$6</p>

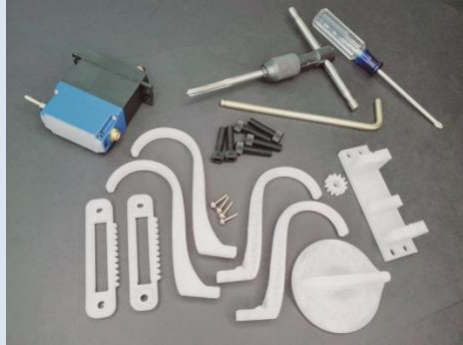
\* These tools are part of the [Smart Servo Marker Space Essentials](#)



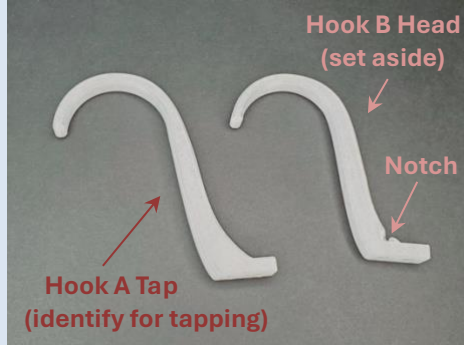
# SMART SERVO GUIDES: BOCCE BALL TILTER

## PART 2: Assembling the Bocce Ball Tilter

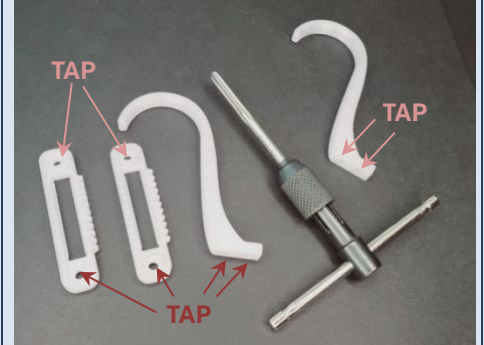
1. Assemble components.



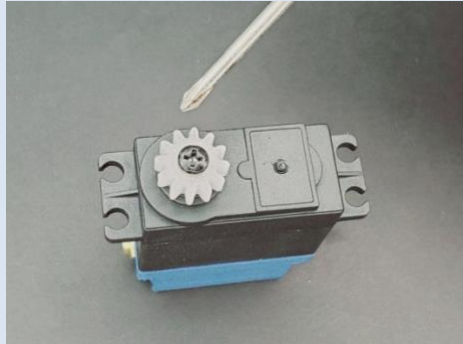
2. Identify the HookATap 3Dprints to tap



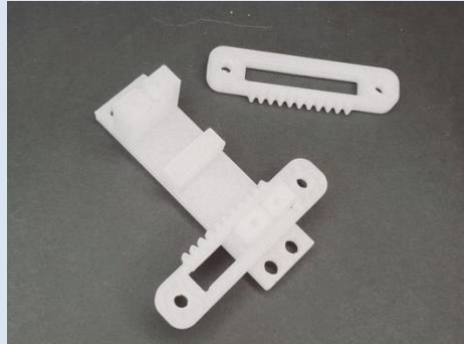
3. Tap each 4.3mm hole with M5 threads



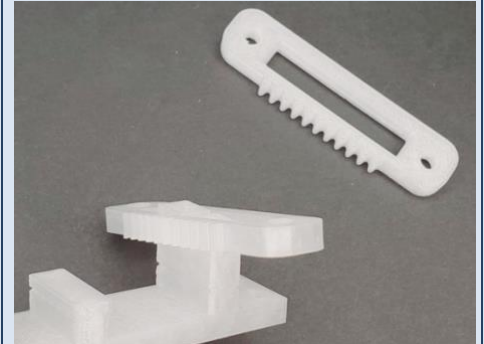
4. Add Drive Gear to the Smart Servo



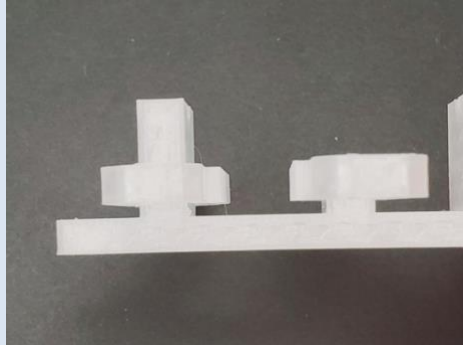
5. Press Racks onto Cover...



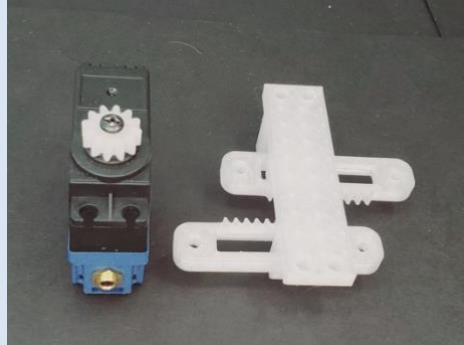
6. Expect the Rack to flex a little.



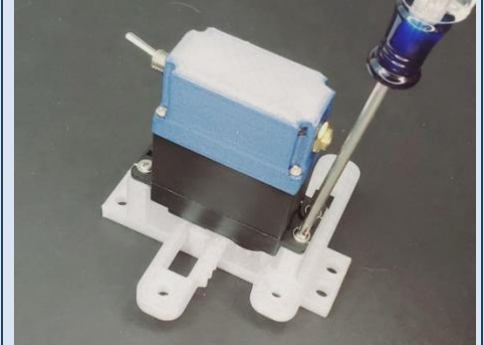
7. The Racks will slide easily once in place with 1 mm gap with the Cover.



8. Orient the Racks to align with the rotation of Drive Gear.

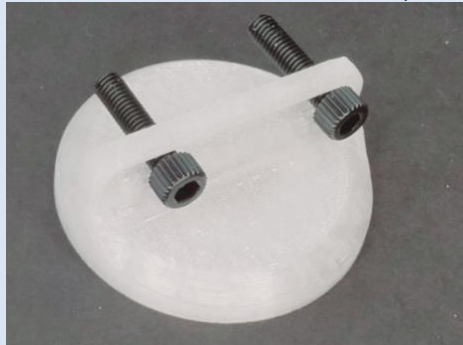


9. Test the rotation\* and use the Mounting Screws to fix the Rack & Pinion in place.

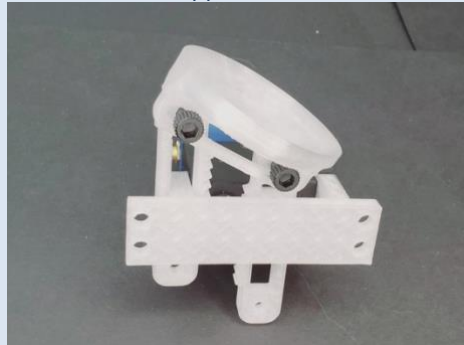


\* Testing – make sure that the full rotation of the gear alignes with the full range of both racks. If there is any squeeking, humming, or buzzing from the Smart Servo, it's under unnecessary stress and you'll have to take apart and readjust the gear teeth.

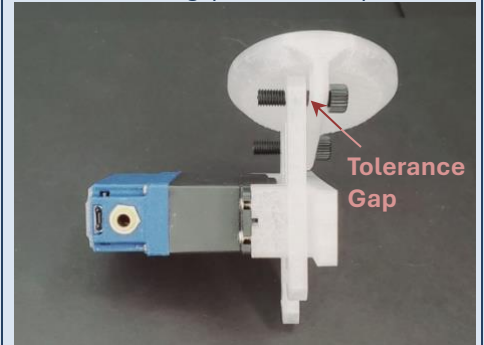
10. Slide 2 M5x20mm screws into Cup.

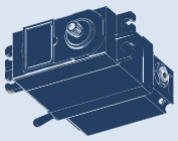


11. Screw into tapped ends of Racks.



12. Leave 1mm gap between Cup & Racks





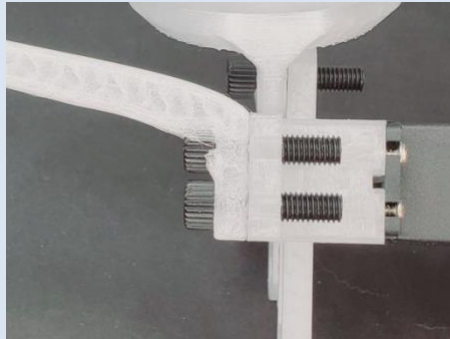
# SMART SERVO GUIDES: BOCCE BALL TILTER

## PART 2: Assembling the Bocce Ball Tilter

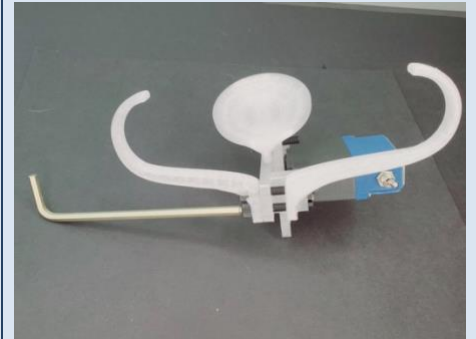
13. Push M5 screws in Hook B Head holes



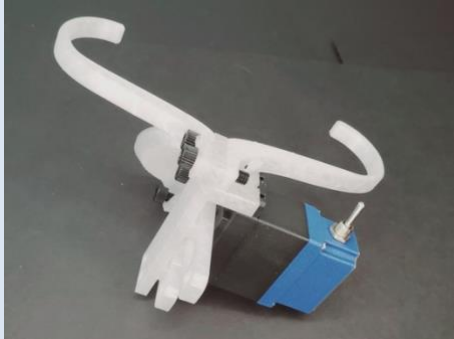
14. Push into Cover holes (will be tight)



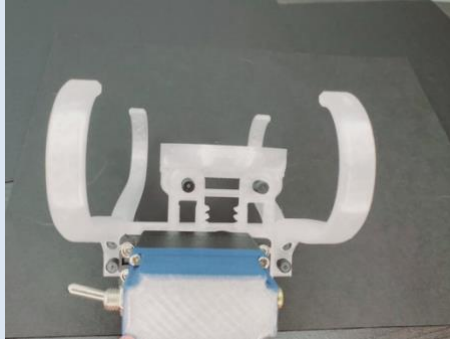
15. Screw into Hook A Tap with M4 Allen



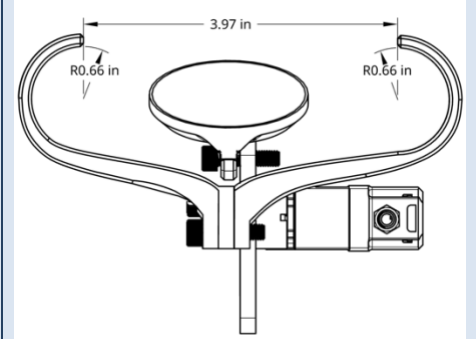
16. Screw in tight.



17. Repeat for second set of Hooks.



18. Prepare for Bocce Ball Ramp\*



\* The Bocce Ball Ramps by *All Abilities Welcome* use 1 inch diameter bars separated by approximately 4 inches. The Bocce Ball Tilter, using PETG filament with a 15% Gyroid infill, will bend and snap into place around these specifications.

19. Hang one end of Bocce Tilter to ramp



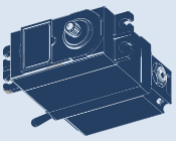
20. Swing up from bottom and snap in.



21. Check that it can support a Bocce Ball.

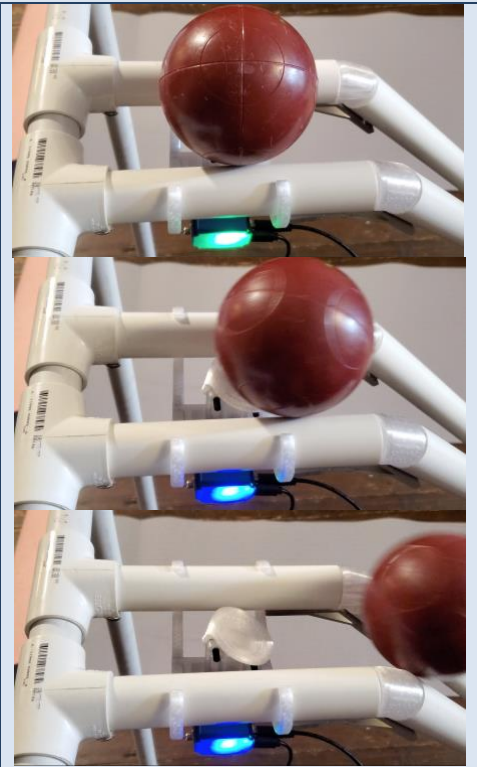
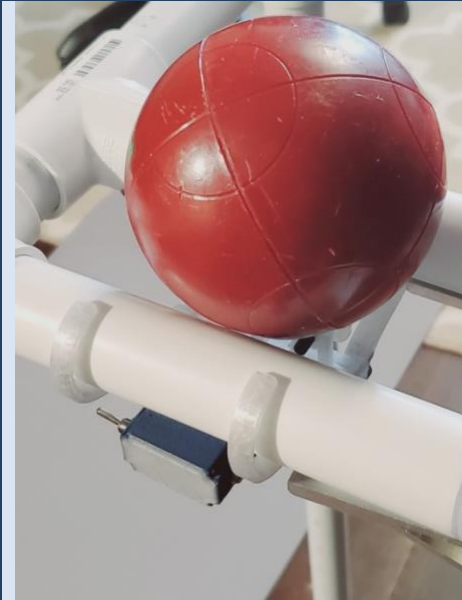






# SMART SERVO GUIDES: BOCCE BALL TILTER

22. Depending on how level the playing field is where the Bocce game is played, there may need to be some adjustments made to the range of the Smart Servo. This can be done in the Python coding. The goal is to find the best initial angle that allows the Bocce ball to be placed and sit still until it is ready to be put into play. Once in play, it should easily roll down the ramp.



22. Tweak the servo1.angle values shown and test until the mechanism works as expected.

```

while True:
    pix[0] = (0,100,0)
    if switch.value == 1 and button.value == 0 and state == 0:
        servo1.angle = 0
        pix[0] = (0,0,100)
        time.sleep(1.5)
        servo1.angle = 180
        state=1
        pix[0] = (0,100,0)
    elif switch.value == 1 and button.value == 1 and state == 1:
        servo1.angle = 180
        pix[0] = (0,100,0)
        state=0
        time.sleep(0.0)
    elif switch.value == 0 and button.value == 0:
        servo1.angle = 180
        pix[0] = (125, 115, 3)
        time.sleep(0.5)
    elif switch.value == 0 and button.value == 1:
        servo1.angle = 180
        for i in range (10,255,1):
            pix[0] = (i,0,0)
        for i in range (255,10,-1):
            pix[0] = (i,0,0)
        time.sleep(1.0)
    time.sleep(0.0)

```

Tilt Angle when Button is Pressed

Tilt Angle when in Reset Position