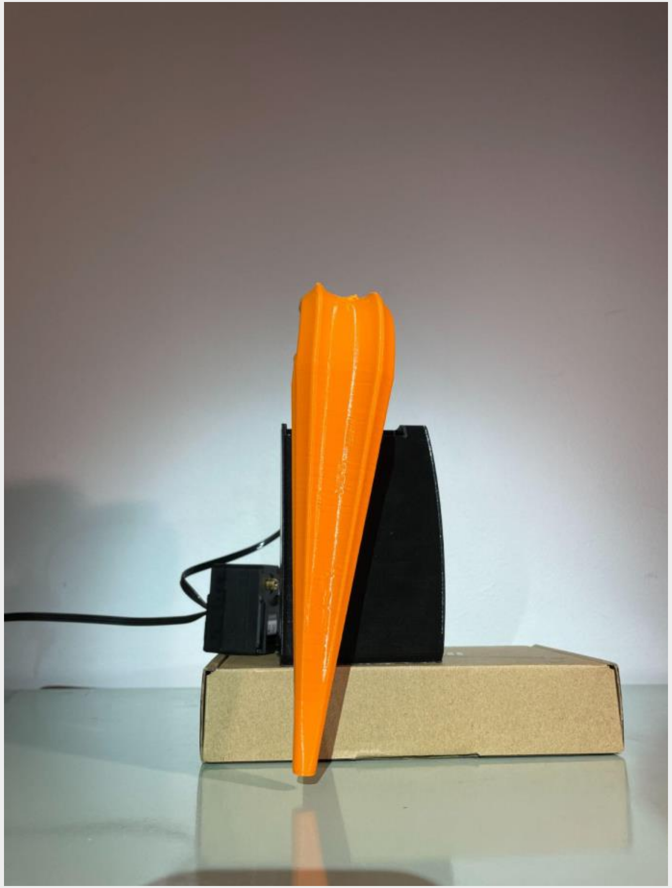
Robotics Studio, Spring 2024

Assignment #4 Working Leg

Kyle Abrahm (KWA11)
Mar 07, 2024, 1:00AM
Grace Hours: 10 hours used, 0 added, 112 remaining

ANTROID

Photos showing leg in motion



Refer to this video, movement is very small right now. This was caused by a fit issue that will be discussed later

commenting constructively and positively on at least three other’s postings

Kyle Abrahm

11:15pm

Super great leg!!! Are you still sold on the torsion spring setup? How are they performing?

Kyle Abrahm

11:17pm

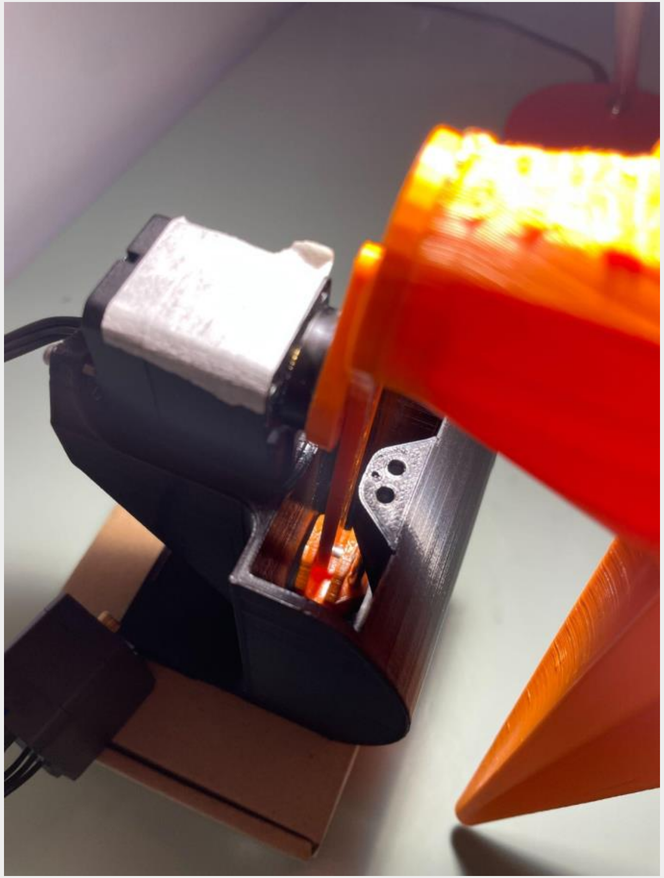
Looks great! Have you considered falttening the bottom of the feet? Looks like there will not be much surface area touching the bottom. Is that your intention?

Kyle Abrahm

11:20pm

Perhaps you could laser-cut acrylic to create a strong control arm. 3D prints seem to bend much easier.

Extreme leg positions tested and measured



As this leg has only one degree of freedom, there are 2 extreme positions: motor pointing 100% north and south. These positions were tested. Pointing North had no issues, but South caused the slider to bottom out and forced a redesign.

Points form/fit issues identified, listed and addressed

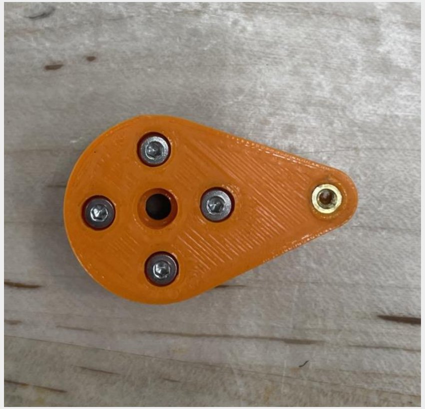
- Tolerancing for press fit: The rods need to be pressed fit for the control rods and for the slider to slider arm pin hole. With the variation in printers, I have devised a method of undersizing the 3D printed holes and then heating an aluminum rod to push through. For the control rods, the same tactic was used as well as lightly hammering the rods into place.

Four iterations of the body were designed to perfect fits

The press fit into the slider has called for 6 iterations. The best technique now is heating up an aluminum rod to slightly enlarge the hole. Then, I freeze the rods, insert, and they expand into place as they cool

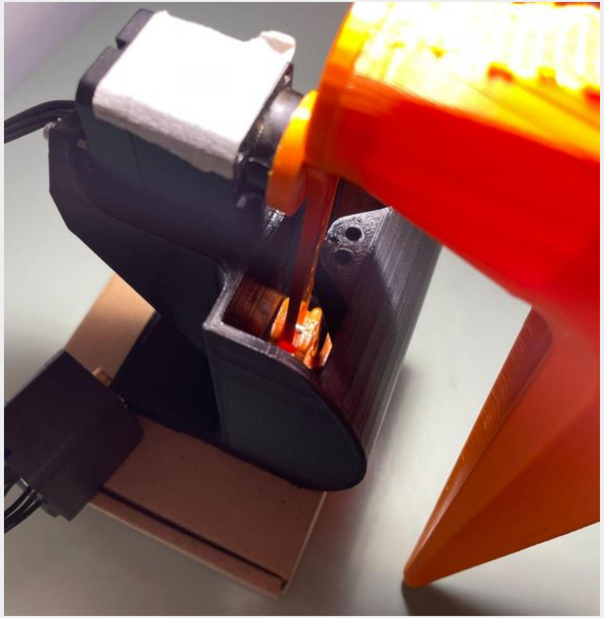
Points form/fit issues identified, listed and addressed

- Attaching the motor to the slider arm has proven difficult. The slider arm needs to be able to slider over this attachment, it needs to attach to the geared motor output, offset the rotation point, and allow for quick customization of the slider arm height. Below are two iterations. The first design did not have inset screws which is when I realized the major design flaw. Design two is perfect and the threaded insert allows for very fast fastening to the slider arm.

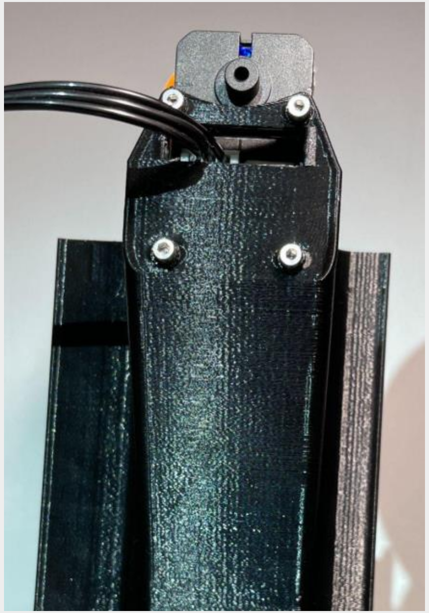


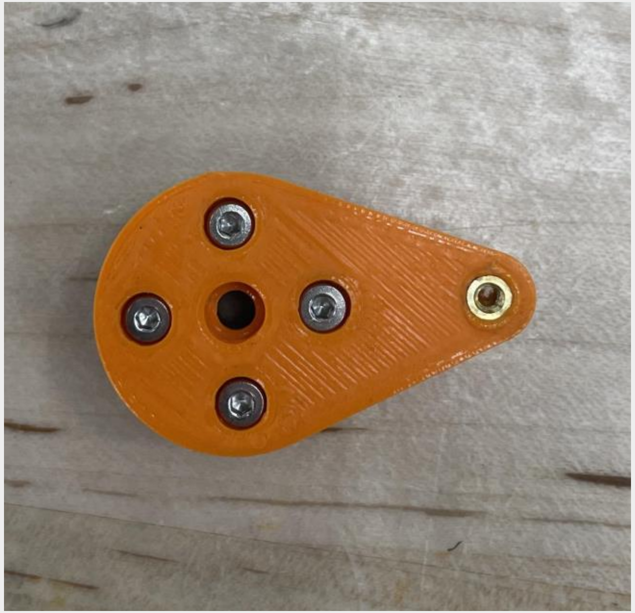
Points form/fit issues identified, listed and addressed

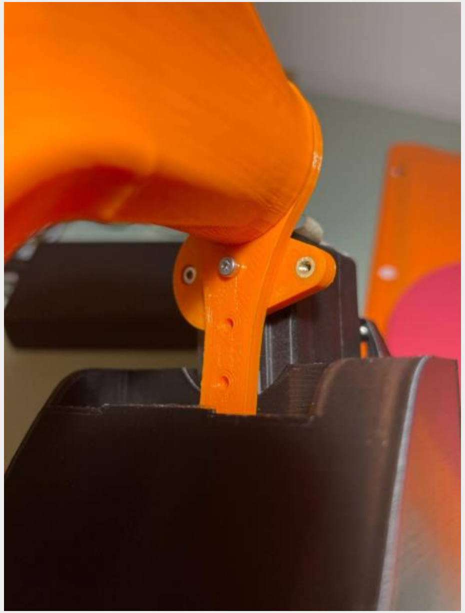
- Creating a sliding fit for the slider forced many iterations and required the box housing the control rods and slider to expand. 3D printer variability meant that each print would differ but thankfully I have a drill bit that creates a perfect sliding fit. The slider now fits cleanly and can move with ease up and down.



All components properly bolted and connected (with inserts)

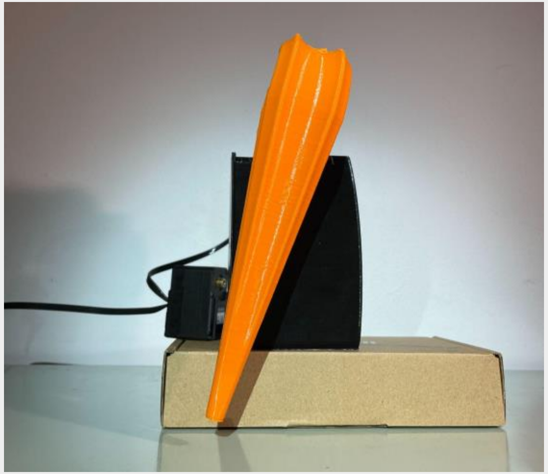






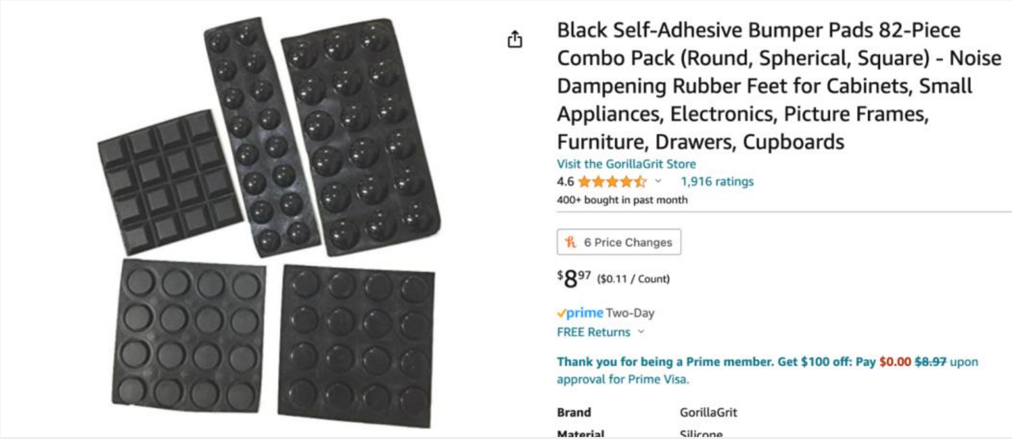
Different leg motion patterns explored

- My robot does not have a wide range of leg movements as there is one degree of freedom. However, adjusting the height of slider arm attaching to the motor changes the ellipse pattern. I played around with this methodology and determined that the highest bolt created the most motion. This was expected as the lever arm was greatest in this configuration. I also played around with the servo mode and the motor mode to start generating ideas about dancing capabilities as the motions are much more specific in servo mode.



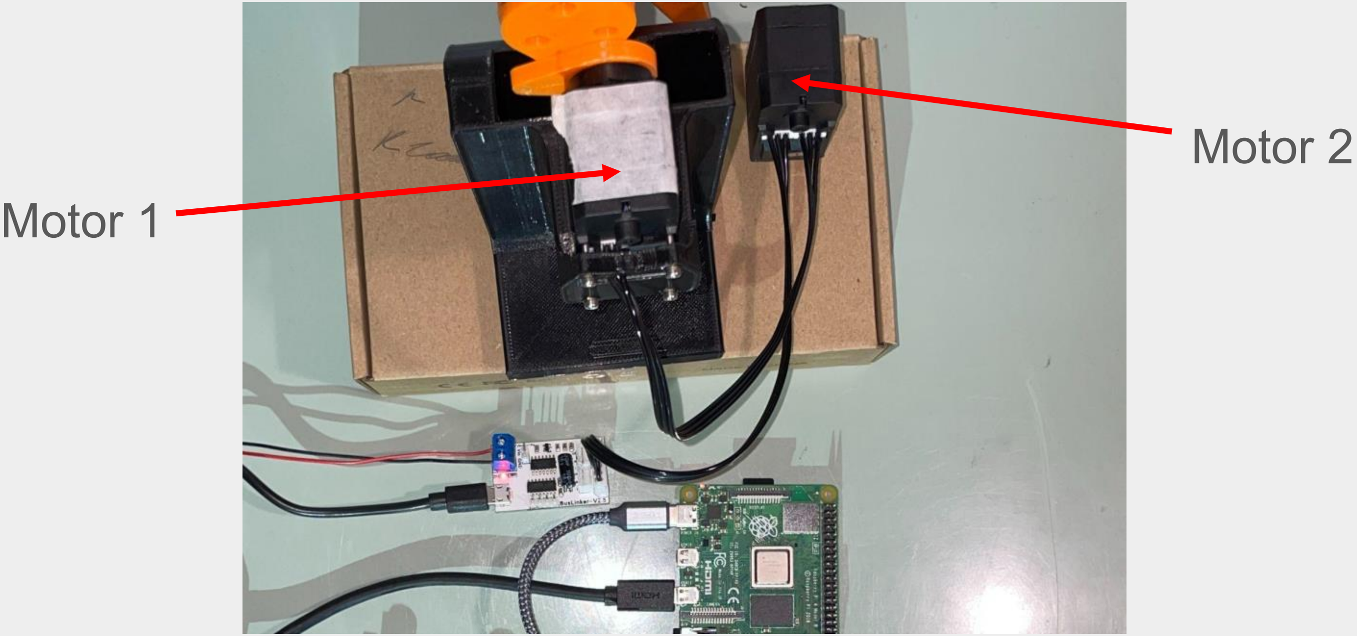
Leg Modularity demonstrated

- There are a few components that are modular for my leg design. First, since the legs get smaller as they approach the ground, the surface area in contact with the ground is minimal. Therefore, I have ordered rubber adhesive bumpers to increase the friction with the ground. To add on, I am worried about this robot on soft ground as the pointed feet will easily penetrate non-solid ground conditions. To resolve this issue, I am designing wider feet attachments that are pads that will clip on. Similar to powder baskets on ski poles.

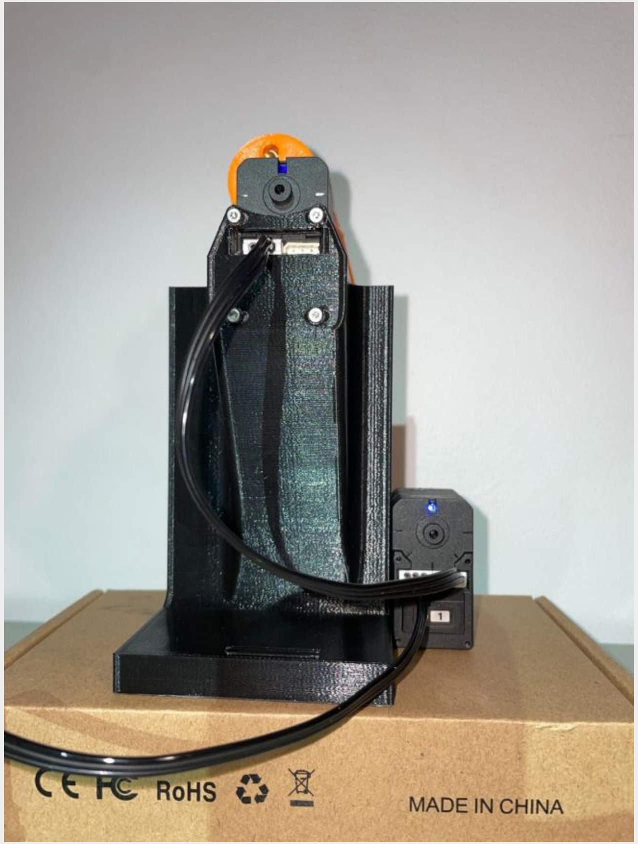


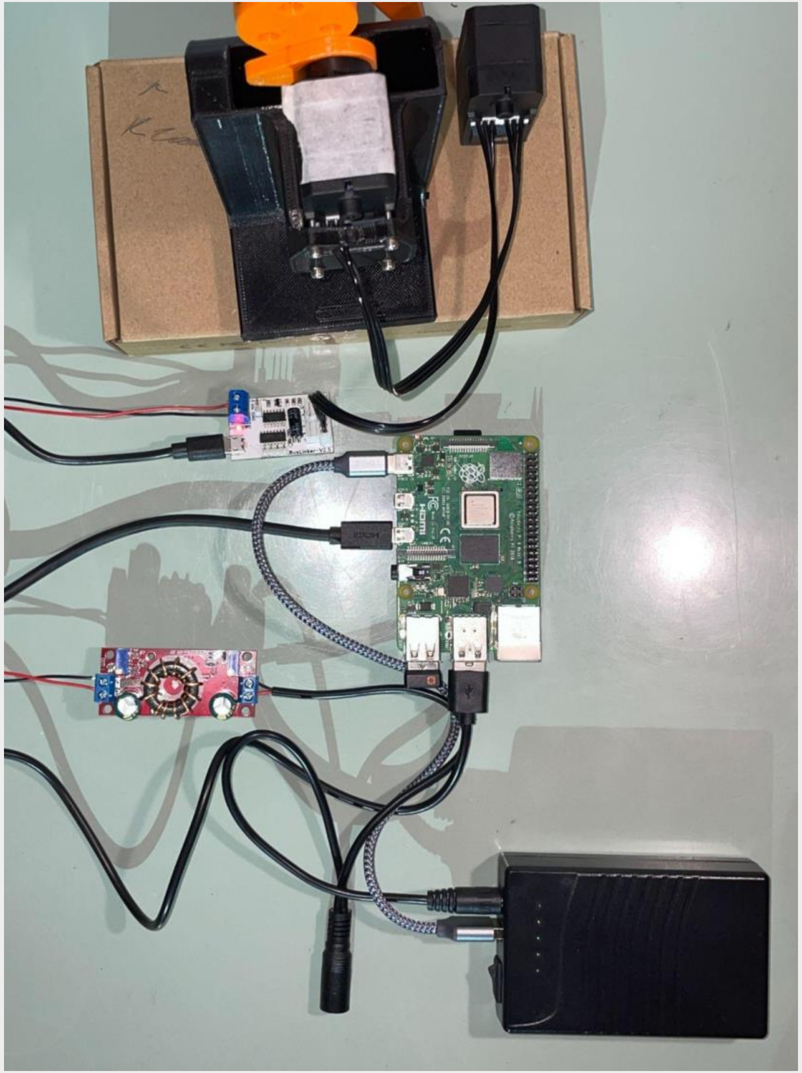
Two or more legs tested in tandem

- As my legs are all independent and EXACT copies of one another, I did not test two identical pairs as this would slow my progress and waste material. However, I did daisy chain a motor to prove that my code and wiring setup allows for more motors to be attached.



Cables routed properly and securely





Rubric

1. **5/5** Points Title slide complete (Slide 1)
2. **5/5** Points overall aesthetics, layout and formatting of the slides
3. **10/10** Points Sequence of photos showing leg in motion (Slide 2)
4. **5/10** Points posting video of moving leg on the discussion board at least 24h in advance of deadline, and commenting constructively and positively on at least three other's postings (show screenshots) (Slide 3)
5. **10/10** Points extreme leg positions tested and measured (Slide 4)
6. **10/10** Points form/fit issues identified, listed and addressed (show how) (Slide 5-7)
7. **10/10** Points all components properly bolted and connected (with inserts) (Slide 8)
8. **10/10** Points 3D-print quality, support structure removed
9. **10/10** Points Different leg motion patterns explored
10. **5/10** Points Leg Modularity demonstrated
11. **10/10** Points Two or more legs tested in tandem (Slide 11)
12. **10/10** Points Cables routed properly and securely (Slide 12)
13. **0/10** Points Exception handling in code catches motor disconnect
14. **0/10** Points if you share your design history with us in Fusion 360 through our scripts.