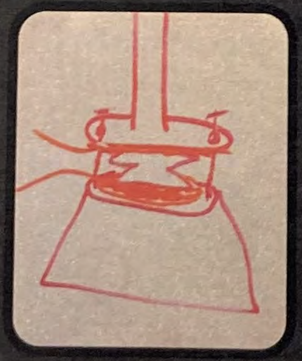
Current Design

- Our current design will be activated by a system of wires that press onto each other whenever the suction cup is pressed onto a surface, completing a circuit and activating the suction motor
- We will have a accordion/concertina style hinge being the connector between the suction cup and the iv tube. That way, the wires are able to connect and complete their circuit more easily



Materials List

- PLA 3d printer filament
- Iv tubing
- wires
- Bendy straws
- a small suction motor
- 9v battery

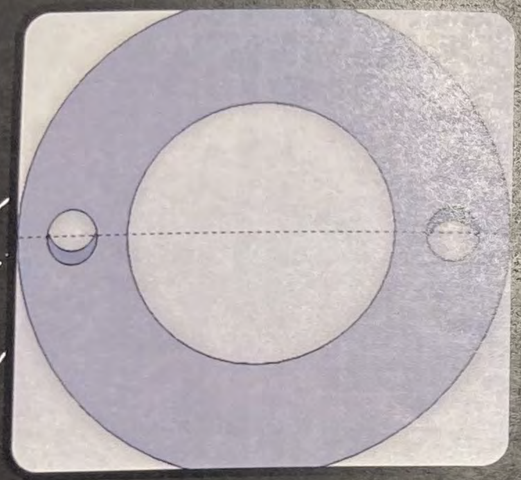
Suction Cup project

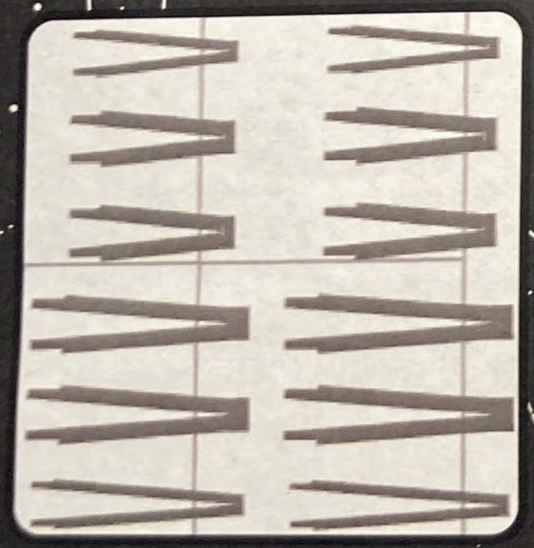
Lakewood Highschool
NASA HUNCH

Raine, and Roman

Ms. Pederson

Current CAD models





Research

For iteration 2 we focused more on the mechanisms behind the suction cup, the methods of activating/deactivating the suction cups. We also researched how we could mechanically make the suction cup automatically activate upon interacting with a surface

Research

We also needed a way for the suction cup to release its hold after it has already grabbed on. For this we researched what the possible benefits of a covalent mechanism could be in making a kind of spring in order to return the activation mechanism to its resting position, that or we could have some sort of timer that deactivates the motor after a certain amount of time (around 5-10 seconds

Testing

Suction Cup

For the suction cups we used and ested three materials: silicone, flexible esin, and TPU. To test the suction cups' rigidity and suction capabilities, we applied a pressure and flexibility test. The 3D-printed flexible resin and TPU prototypes were too rigid to suction roperly. The TPU prototype was more rigid than the resin and often shed layers when testing flexibility. he silicone prototypes didn't quite set right and weren't rigid enough to ithstand any meaningful force, as such hey weren't rigid enough to withstand any meaningful force. However, they ere quite flexible and, given that they could set right, would be the ideal material for the suction cups.

UP

DOWN

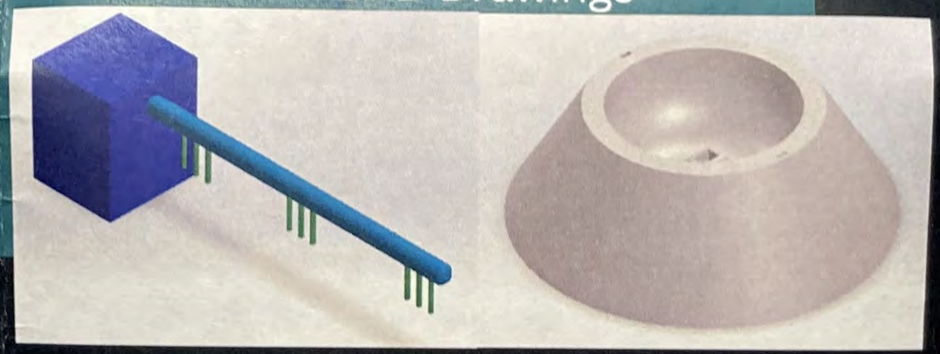
Mechanism

We used two prototypes for the mechanism, one to test the mechanical function and the other to showcase the touch sensors.
To test the mechanical prototype we attached a store-bought suction cup to our mechanism to mimic the conditions it would experience on the ISS, which it maneuvered perfectly.
To test the touch sensor prototype we had it rotate until the circuit closed, turning on a light. The light turning on is meant to mimic the indication that the touch sensor is stopping the mechanism.
Both of these tests can be seen in the video which can be seen through scanning the qr code on the back.

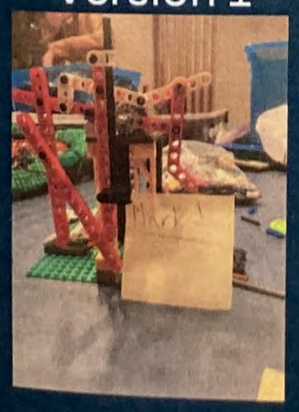
Prototype

We have made a few versions of our mechanical prototype. The first one was big and clunky and since then we have been able to scale it down width wise and add more plungers to show the true goal of our prototype. For the actual mechanism we used a lego technic motor, 16 tooth gears, and gear racks to push down plungers onto the suction cup to have the suction cup suction on to a surface.
The suction cup that we used in our final prototype is just a generic store bought suction cup. This is different from our final design which can be seen in the CAD drawing below.

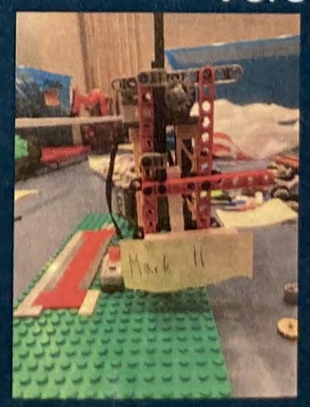
CAD Drawings



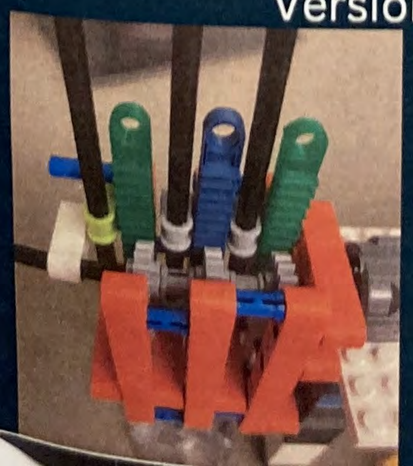
Version 1



Version 2



Version 3/Final



Plans For The Future

We have two goals for the future, the first is to make a functioning suction cup with our design. So far the versions we have made have not worked whether they have been too weak or too hard. Th second goal is to focus on the mechanical part and make it s that it can suction onto curve or rounded surfaces and to take out the LEGOS and make it out of a different material.

Sources

"Suction Cups 101." Adams Manufacturing, suctioncups.com/pages/suction-cups-101#:~:text=The%20Science%20on%20How%20a%20Suction%20Cup%20Works,-Imagine%20that%20everything&text=When%20you%20press%20a%20suction,want%20it%20to%20stick%20. Accessed 22 Aug. 2023.

Guide Automata 02 - Exploratorium, www.exploratorium.edu/sites/default/files/tinkering/files/Instructions/cardboard_automata_guide_final_screen.pdf. Accessed 6 Feb. 2024.

Shawn. "Touch Sensors: What It Is, How It Works, Arduino Guide." Latest Open Tech From Seeed, 28 Mar. 2022, www.seeedstudio.com/blog/2019/12/31/what-is-touch-sensor-and-how-to-use-it-with-arduino/.

Suction Cups

Myla Gettings &
Freya Schaefer

Ashley Pederson
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Video/More Info

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Materials

- Metal Wiring
- Small metal pole
- 3D Printed Poles
- 9V Motor
- Silicone Suction Cup
- Touch Sensors
- Electrically Powered
- Spring Plunger

Research

There are three key concepts that make it easier to understand our prototype; suction, automata mechanisms, and touch sensors.

Suction: Suction is created using a pressure differential. This is achieved electronically, mechanically, electromagnetically, and/or hydrolytically. It's most commonly used today in vacuums and suction cups.

Automata Mechanisms: These function as a load running along a series of elliptical cylinders attached to a pole at set intervals, causing the load to go up and down at different heights. It's most commonly used in Automata toys and the engines of cars.

Touch sensors: When used in a

NASA Hunch Robotic Suction Cup

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OUR WEBSITE

PROTOTYPE

MEET THE TEAM

Vincent Hoffman

Rob Willis

TESTING

Ability to change shape:

Trial	Curved metal surface (30-45 degree angle)	Curved glass surface (30-45 degree angle)	Any curved surface (60-90 degree angle)	
1	Stuck to surface	Stuck to surface	Not able to change shape/suction	
2	Stuck to surface	Weak suction	Not able to change shape/suction	
3	Stuck to surface	Stuck to surface	Not able to change shape/suction	

Ability to attach/detach from flat/smooth surfaces:

Trial	Smooth/flat Metal	Smooth/flat Glass	Smooth/flat counter
1 (pulled ¼ back)	Attached easily, firm suction created	Attached easily, firm suction created	Weak suction created
2 (pulled 2/4 back)	Attached easily, firm suction created	Attached easily, firm suction created	Weak suction created
3 (pulled ¾ back)	Attached easily, firm suction created	Attached easily, firm suction created	Weak suction created

Ability to attach/detach from curved/smooth/rigid surfaces:

Trial	Smooth metal surface	Curved metal surface	Rigid metal surface
1	Firm suction created	Firm suction created	No suction created
2	Firm suction created	Firm suction created	No suction created
3	Firm suction created	Firm suction created	No suction created

KEY RESEARCH:

- PSI on the ISS is slightly less than Earth (14.7 PSI) due to oxygen concentration.
- *Most suction cups are made of flexible PVC plastic or Neoprene.*
- *The International Space Station uses handheld vacuums and cleaning wipes to disinfect the station every week.*
- *Servo Motors are a very powerful (270-degree) rotational motor*

THE PROBLEM:

- How can we develop and design an automated octopus-like suction cup that attaches and detaches from surfaces and creates a perfect vacuum, which will be incorporated into a Robotic Duster, used to clean the ISS?

SUBSYSTEMS

- **Syringe holder system (prevents syringe from moving when servo is activated**

- **Gear teeth connecting rod with modified gear. When the servo button is pushed, the gear will retract the rod, pulling the syringe back, creating a suction**

- **Modified gear drilled into original circular gear**

EARLY PROTOTYPES

MATERIALS:

3D Printed Parts

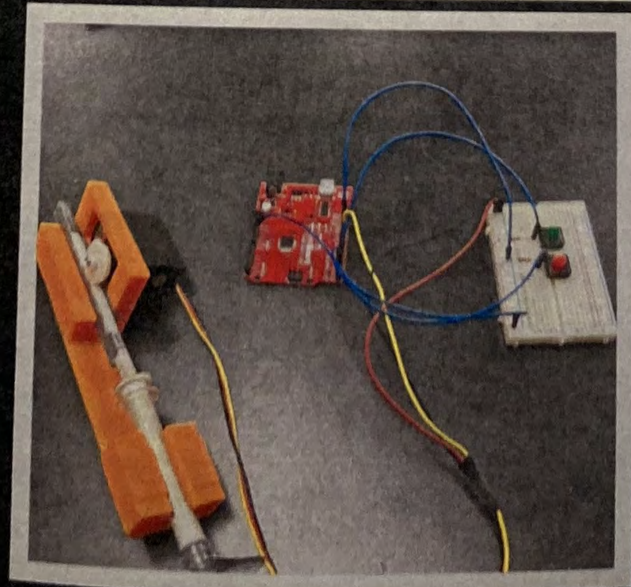
- *The bulk majority of our prototype is custom 3D printed parts made from a thermoplastic filament.*

Plastic Parts / Suction Cup

- *Both the gear and connecting rod are made of cheap plastic, nylon.*
- *Our current suction cup is a 2-inch PVC cup bought from ACE hardware which we modified by drilling a hole in it.*
- *2x 1.875CC medical syringe made from Polypropylene.*
- *Modified 3D Printed plastic gear*

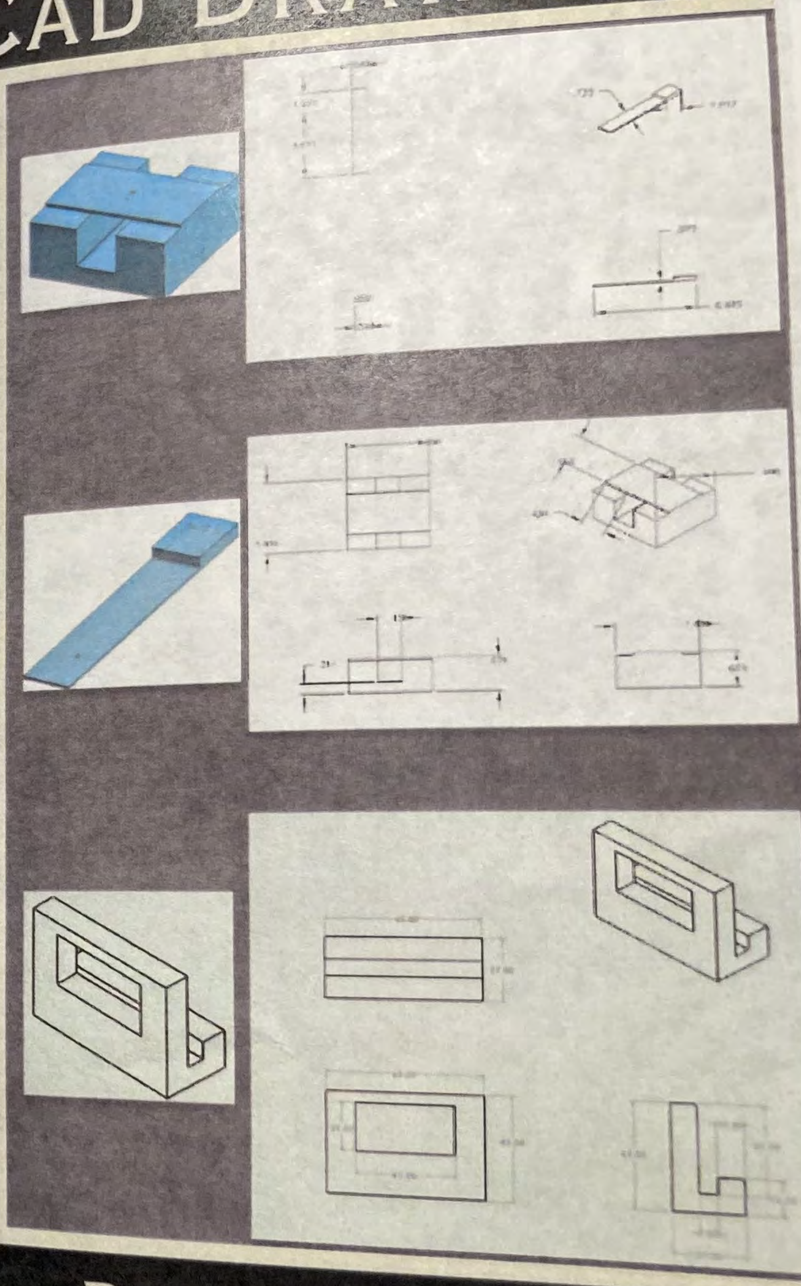
Hardware

- *2x HITec HS-311 Servo Motor*
- *Sparkfun RedBoard with micro breadboard*
- *2x Mini Push Buttons*

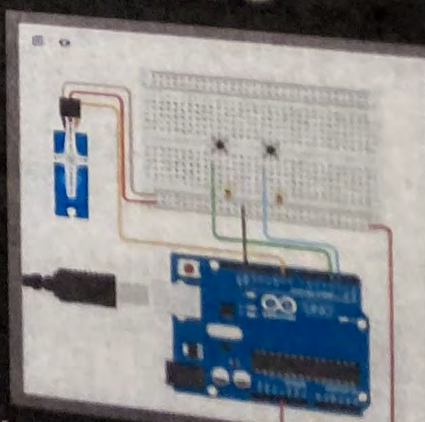


Final Prototype

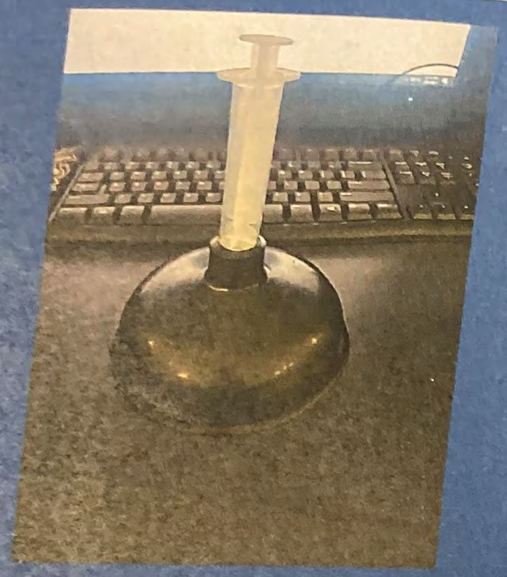
CAD DRAWINGS



PROGRAMMING



We used a servo motor attached



Project overview

NASA would like to demonstrate the feasibility of an octopus-like, soft robot that can crawl around the inside of the Starlab or Axiom Space Stations using flexible arms and suction cups on handrails and flat or curved, smooth surfaces for mobility and uses some kind of duster appendage to remove dust from the walls of the space station.

Octo-Cup

Idea description: The Octo-Cup is a powerful yet delicate suction cup that is inspired by octopus anatomy. It can easily attach and detach and can mold to any surface.

Prototype Attempts

Images of Prototype (CAD) Drawings

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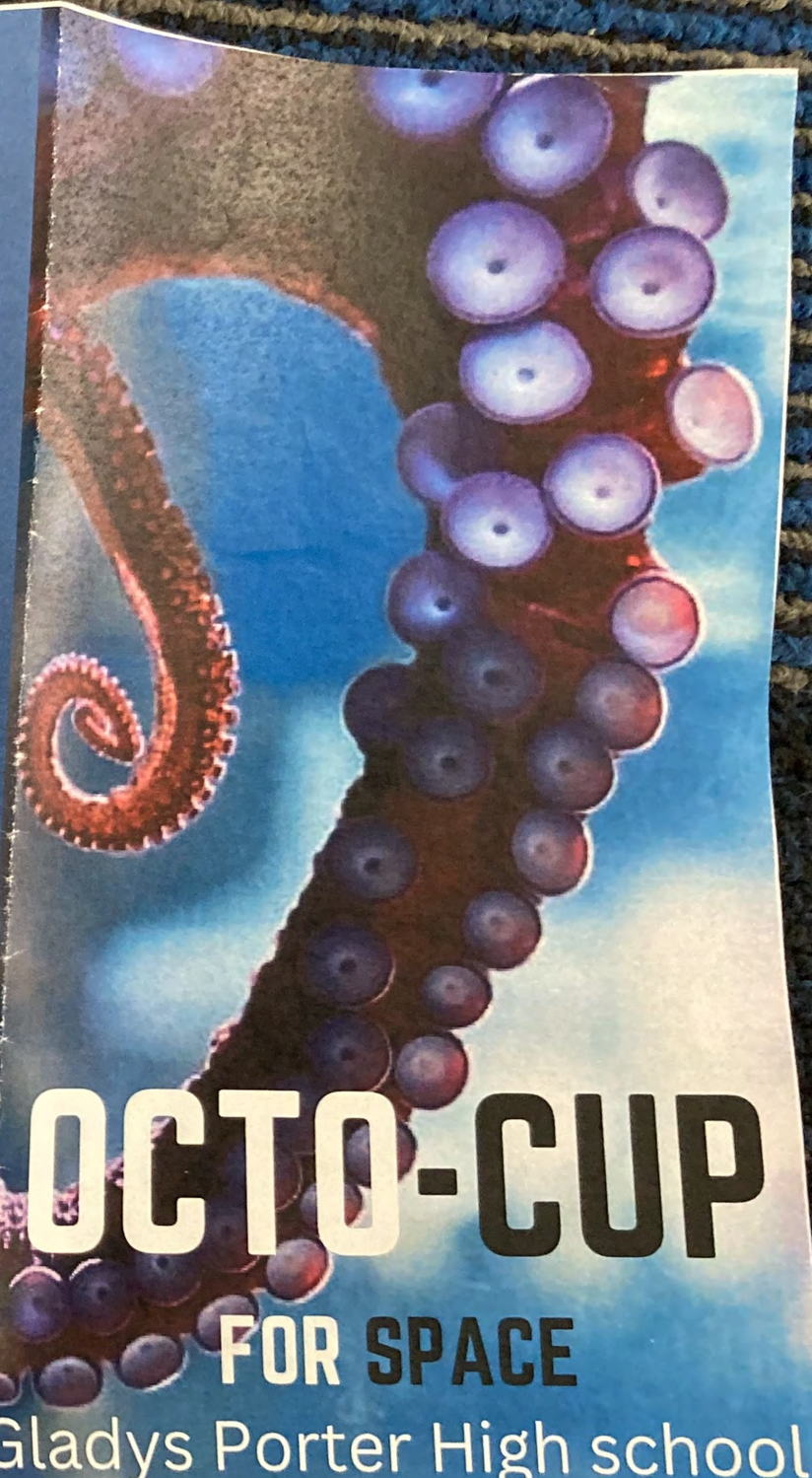

OCTO-CUP

FOR SPACE

Gladys Porter High school

Andrea Zuniga,Troy Martinez,Sofia Salinas