Note to Semi-Finalists

Thank you very much for participating in the HUNCH Design and Prototyping. This was by far the most difficult year for deciding finalists. Part of the difficulty was the number of teams participating but the most important part was the number of high quality of prototypes for each of the 10 projects.

Each Mentor helped choose potential finalists for their area and were then compared with the same type of projects across the country. Teams that were selected to be finalists had very tough competition and it was very difficult to down select. Although everyone wants to be a finalist it isn't possible and decisions have to be made. Some of the decisions include the requirements but also trying to show diversity of how the problem could be solved. There was no shortage of good and diverse ideas.

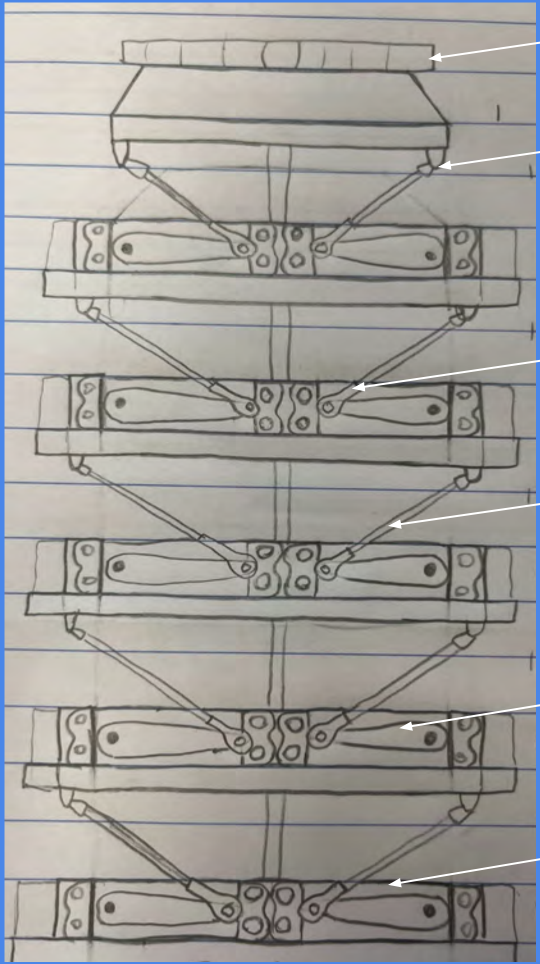
Being a Semi-Finalist is a great honor because each of you put together a project and data that made the teams think, learn and be excited about space. Your great ideas and hard work is what makes NASA HUNCH a challenge and a great experience for engineering. We hope you enjoyed the projects as much as we all enjoyed seeing your prototypes.

If you are a senior and moving on to college, industry, or trade schools, make sure you include your project with NASA HUNCH on your resume. You will find that your interview will center on "what did you do for NASA?" The more you tell them, the more they will want to hear. You will be receiving a letter of recommendation from NASA HUNCH describing Design and Prototype and the project you worked on. We hope that your work will translate to opening doors for your future. Thank you for being in the NASA HUNCH Design and Prototype Program.

NASA HUNCH Mobility Arm

Meridian Technology Center
Mr. Mantooth
Parker Moore, Jonathan Mendoza, Ryan Winterhalter

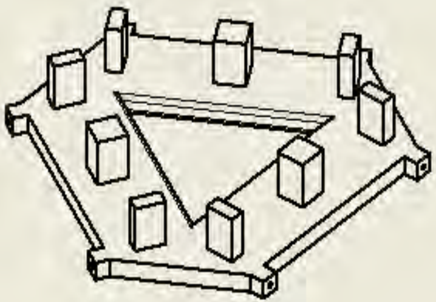
This mobility arm excels in various applications, prioritizing key constraints. The Arduino joystick setup ensures ease of control, allowing precise manipulation. Tougher materials make the arm resistant to cuts or tears. Maneuverability is achieved through a 100-degree bend capability. Extension and retraction of about 12 inches enhances versatility. The rotating mechanism enables grasping from multiple directions. The two suction cups would be placed on the protective sleeve's exterior.

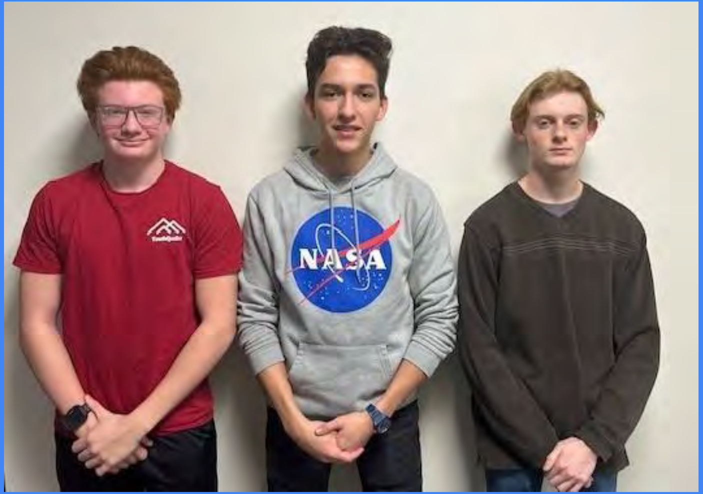



Rod-Servo Horn Adapter


Soft Claw Platform


Rod-Platform Adapter

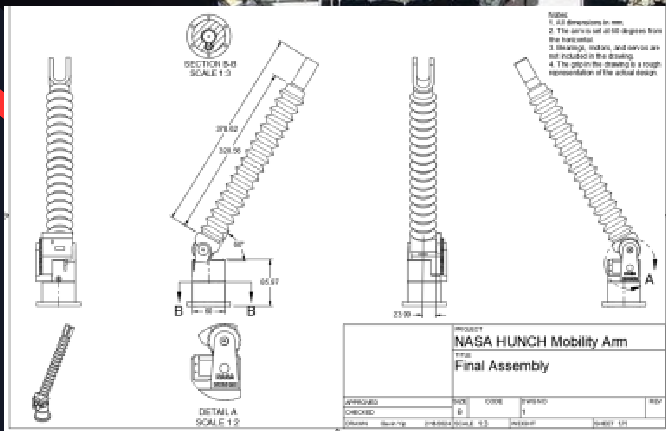

Servo Motor Platform



CAD DRAWINGS

Base

Full Assembly



Full Assembly with Measurements

CONSTRAINTS

- Utilizes TPU and silicone both soft materials that will prevent any damage to either people or the space station.
- Has a rotatable base and a gear system that allows the arm to move in various directions with ease.
- Claw is a simple shape that can grab onto different handrails of various dimensions.

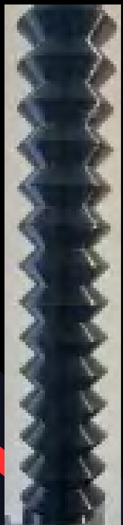
TESTING DESCRIPTION

- The base moves smoothly and is easy to function. It rotates and moves arms to different positions.
- The claw, although it does close, could be stronger and close more firmly.

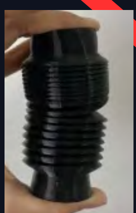
PREVIOUS DESIGN

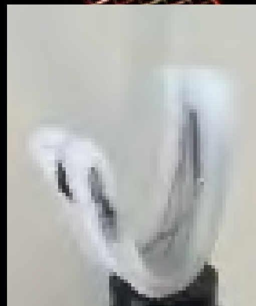
- Current arm stretches and compresses a larger distance than previous design
- The current design now utilizes much more softer material
- The current design is more lightweight and takes up less space.

OUR DESIGN



Compressible Arm





Claw

Base

- Arm is inspired a pop tube and is printed thermoplastic polyurethane (TPU), a soft material. This allows for the arm to compress and have a displacement of 12 inches.
- The base is rotating allowing the arm to move to various positions.
- Claw is made using silicone and the interior contains nitinol wire. This wire when applied with voltage, will return to its original shape, allowing the claw to close and open.
- Utilizes a pulley system that will pull down and compress the arm.

QR CODE

Meet the Team: Aliyyah Nazim, Gavin Yip, Diego Romero, Omer Ertural, Areeb Atif

Teacher: Salsabiel Mujovic

Passaic County Technical Institute
45 REINHARDT ROAD WAYNE, NJ 07470-2210

KWADROPUS MOBILITY ARM

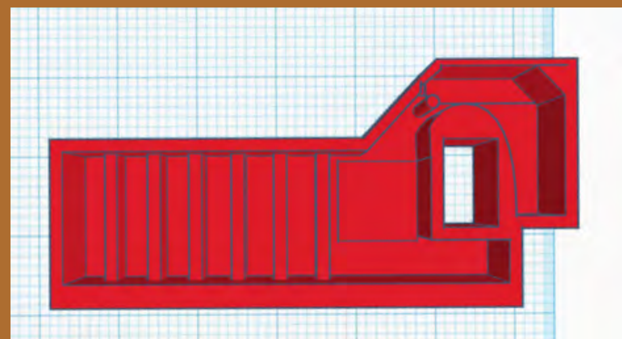
DESIGN AND PROTOTYPE

CENTRO RESIDENCIAL DE OPORTINIDADES EDUCATIVAS DE MAYAGÜEZ, PUERTO RICO
ETHAN CUBERO
DEREK GONZÁLEZ
HEDIELBERTO BARRETO

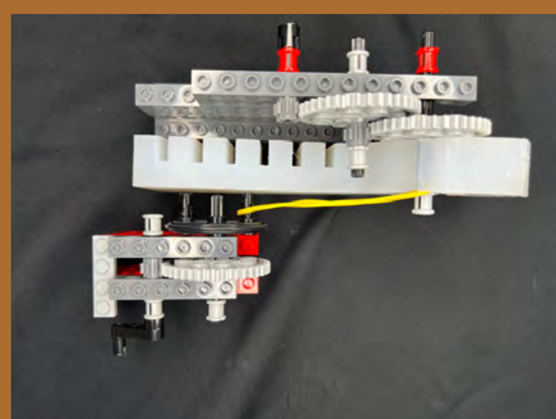
MISSION

Develop a robotic arm with minimal rigid parts, using silicone for grip and weight. Key feature: combined with outside mechanical force for enhanced arm movement, enabling self-pulling along a handrail.

3D MOLD



3D MODEL



DEMONSTRATION VIDEO:

UTILIZATION

Its flexibility, adaptability, and lightweight design ensure seamless navigation through confined spaces, contributing to spacecraft weight savings. Compliance enhances safety in collaborative tasks, and fault tolerance offers reliability in dynamic space environments. The rope system pulling the hand make it a practical choice for space missions, promising to revolutionize exploration beyond Earth's boundaries.

WHAT WE OFFER

INNOVATION

Silicone soft robot arm with a rope system, that pulls the hand and arm to either side. This make it simple to control and easy to maintain.

CREATIVITY

Soft robot arm creatively integrates compliance and fault tolerance.

EFFICIENCY

Silicone soft robot arm: Minimal components, lightweight design for optimal spacecraft efficiency in space missions.

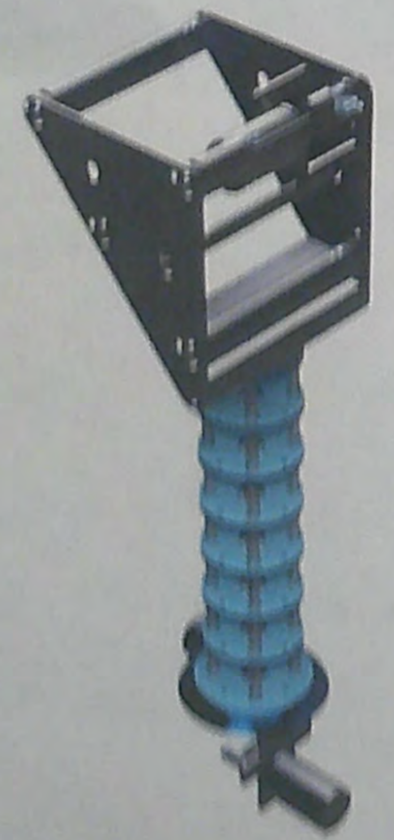
ESPECIFICATIONS

Width: 5 1/2 inches
Height: 2 1/2 inches

55

KWADROPUS ROBOTIC DUSTER ARM

JACOB CASTRO
JOSEPH GOH
NAWAL SIDDIQUI



GOAL

Create a flexible robotic duster arm that collects human skin cells and hair follicles, food crumbs, and clothing lint efficiently in a

VERSION 1

DESIGN

- 4 springs for stability and control over orientation.
- 2 motors for multi-axis rotation.
- Built-in brush for longer cleaning span.
- Microfiber for simple maintenance and minimum waste.
- Powerful DC motors will ensure effective performance.
- Removable belt will allow for easy cleaning with a vacuum.

TESTING

BENDING

The arm successfully bends more than 90 degrees in each direction.

CLEANING

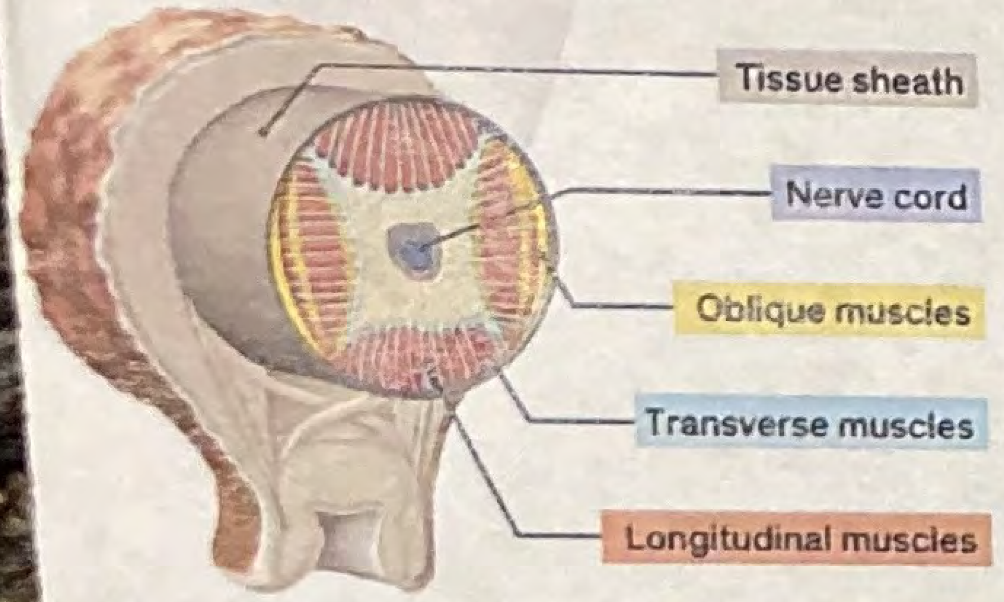
The belt duster design expands dust retention by creating more surface area.

MICROFIBER

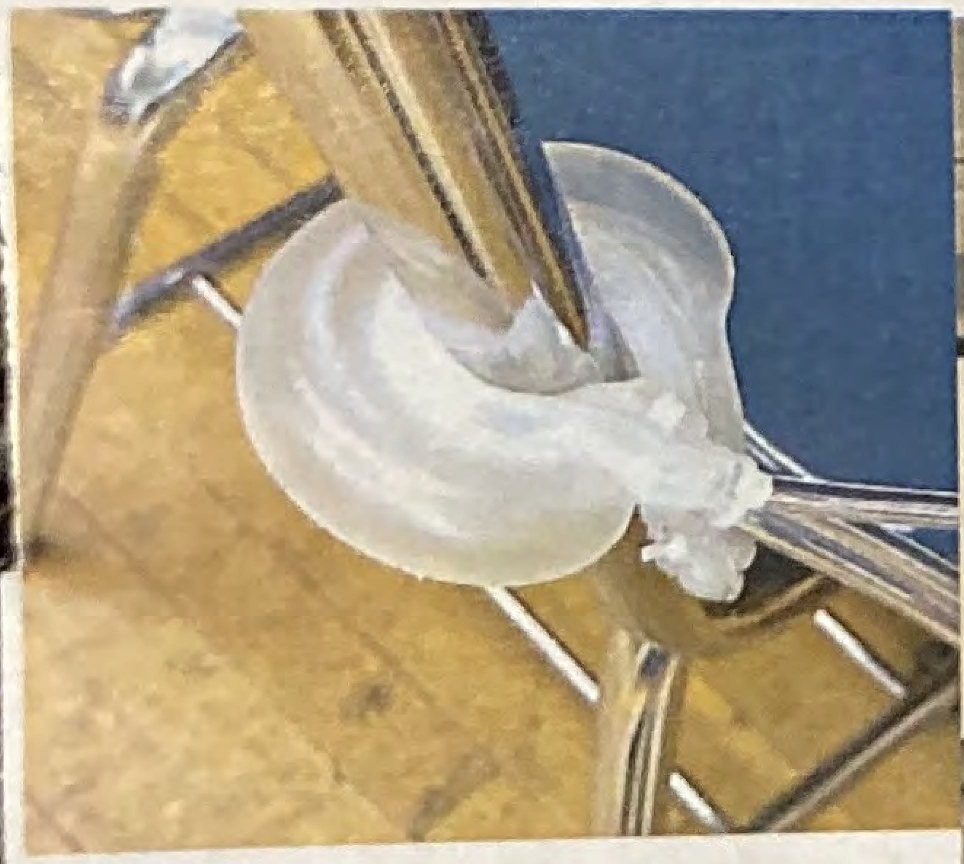
After 3 wipes the microfiber holds 70% of the starch and the brush removes 26% of it.

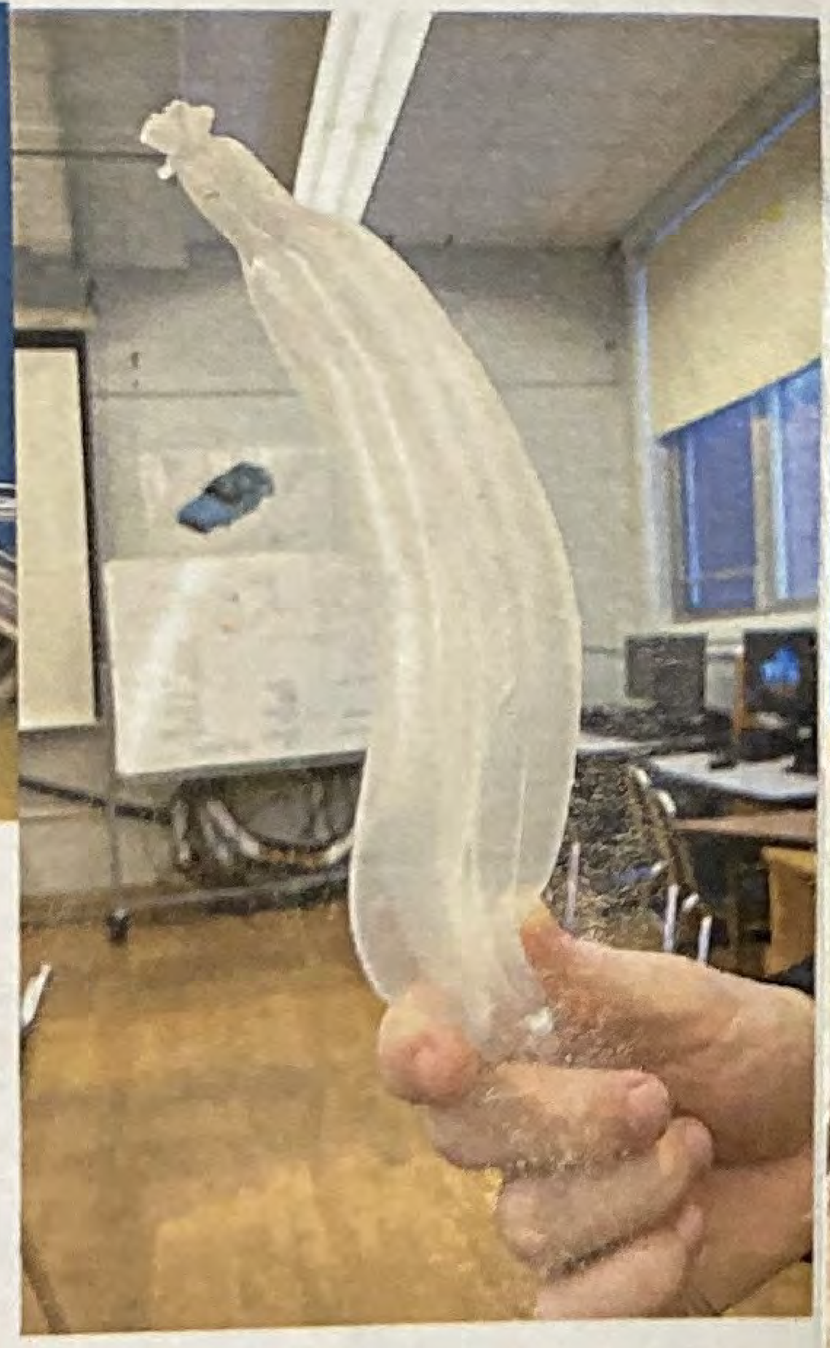
EBSITE

Hydraulic Grabber



Inspired by the musculature of real octopus arms. Bladders inflate and deflate to wrap around handles similarly to the way muscles expand and contract.

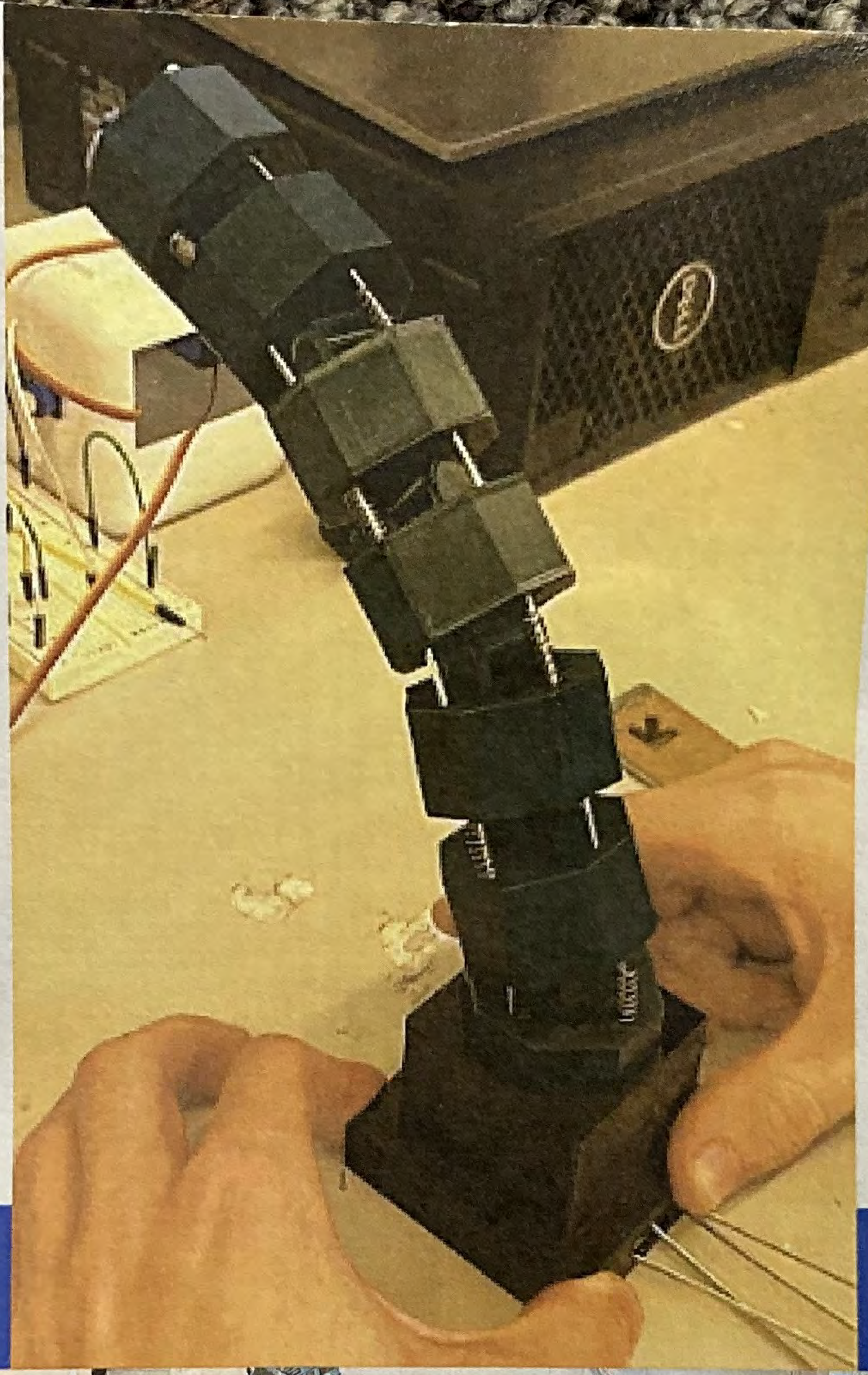


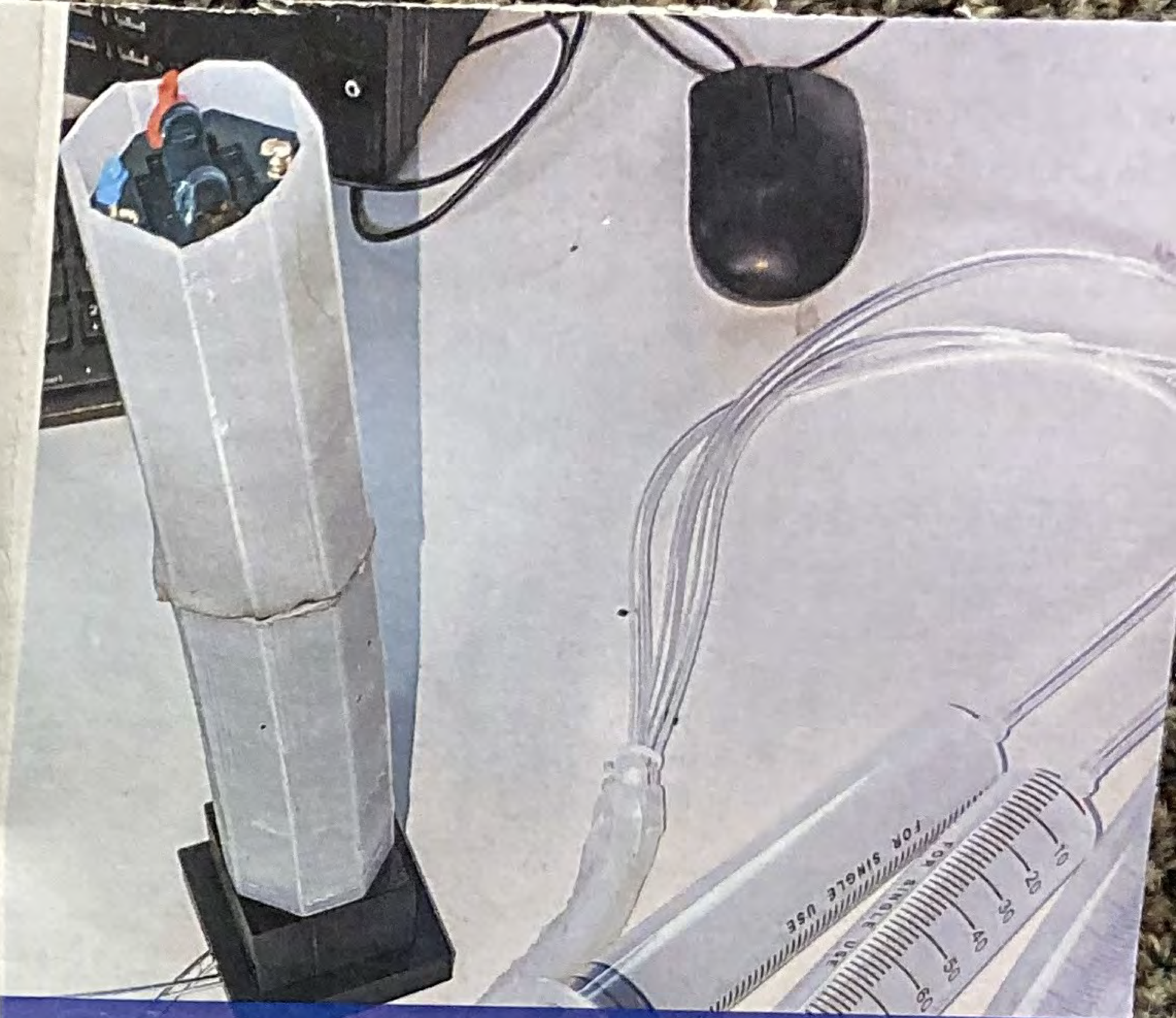


Measurements:

5.5" x .75" (Deflated)
10" x 1.75" (Inflated)

Bladders are made out of silicone





Kwadropus

MOBILITY ARM

Frontier High School
Hamburg NY

George Ouimet - Teacher / Mentor

Purpose Of The Kwadropus

Astronauts spend 1-2 hours every week cleaning the ISS. This poses 2 major problems.

1. Astronauts are expensive. NASA spends $130,000 per hour on each astronaut aboard the ISS.
2. An astronaut's time is better spent conducting research. Every hour spent cleaning can't be used learning about the secrets of the universe.

The Kwadropus project aims to automate this cleaning process for the astronauts, requiring minimal maintenance. Our task was to create the mobility that allows the Kwadropus to move around the ISS.

Scan for more info about all of our prototypes!!

What Makes Our Arm Special?

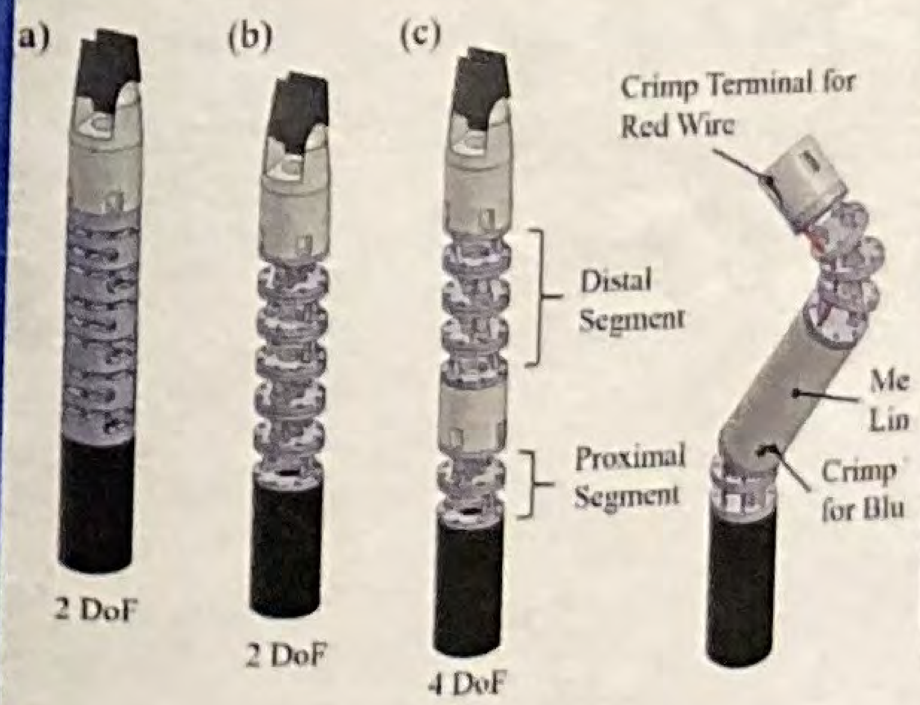
Our arm incorporates a few cleverly designed components to allow for optimal performance, such as;

- Springs that allow for automatic recentering of the arm
- Strong steel brake cables to pull and control the arm
- Hinges facing alternating directions to reduce twisting
- Modular 3d-printed design that is easy to put together, but won't break apart under load
- Currently, the arm measure 8.75″ by 1.7″ on it's own

Inspirations

The initial prototype for this arm was based off a human's shoulder joint. It helped to provide immense amounts of mobility, but was difficult to control and tended to get twisted. This current prototype is based on different surgical robots that use a slightly similar system. For more info about this initial prototype and the inspiration, scan the QR code!

Inspiration Vs. Prototype



Pictured left to right in ascending grade level:

Jimmy Connors, Mathias Hasselback, Matthew Bellanca, Adriel Rosado, Amelia Cole

Soft Arm

Warren Tech

Dakota Ridge

Mr. Olsen

Grayson Fink

(Pictured above is segmented actuator)

The Soft Arm project is part if the 2024 H.U.N.C.H project list. The proposed solution to the problem is to create a robotic arm from molded silicone. This arm is controlled by compressed air and a motor at the bottom which turns the orientation

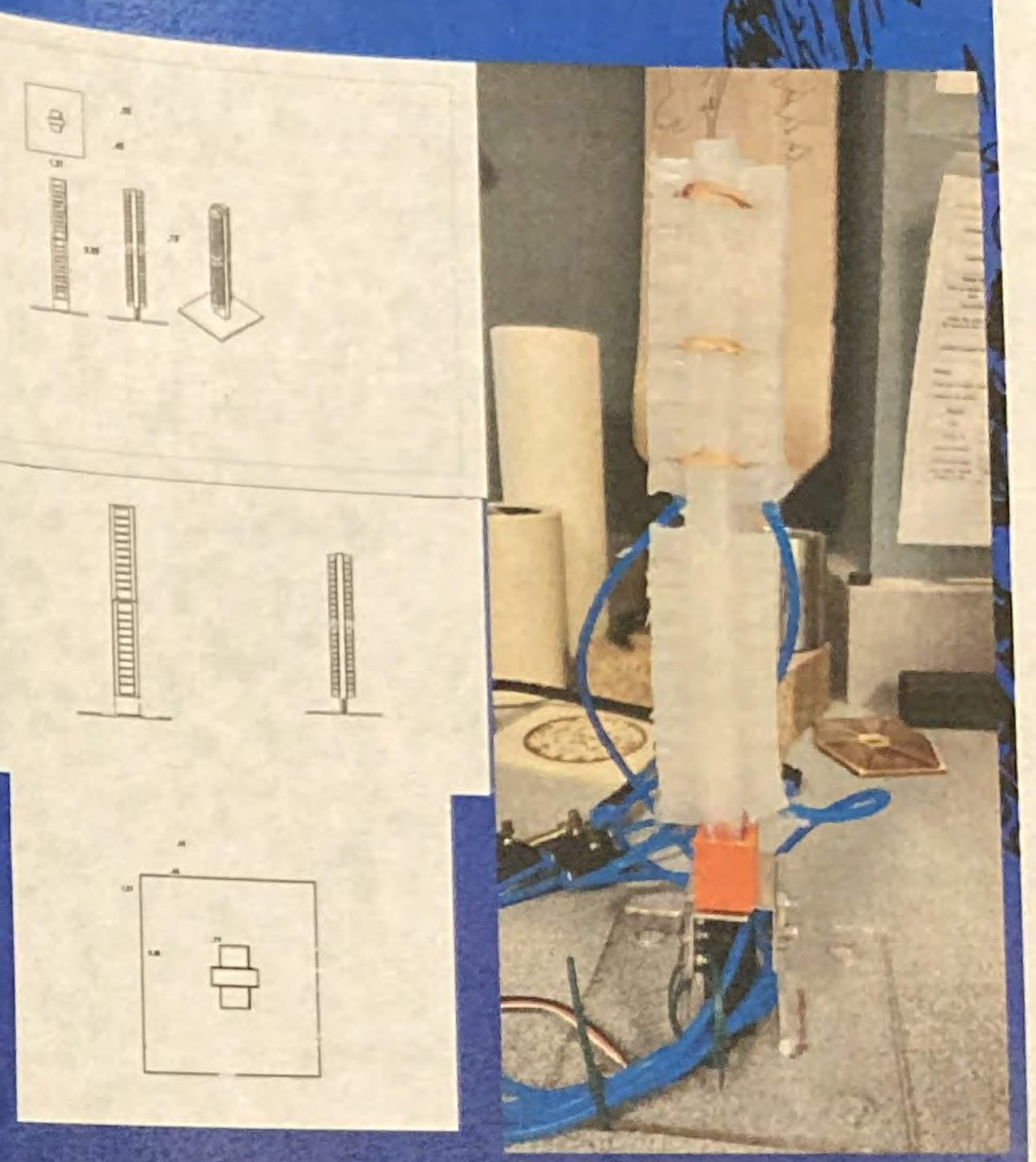
SCAN ME

For More Information

WARREN TECH

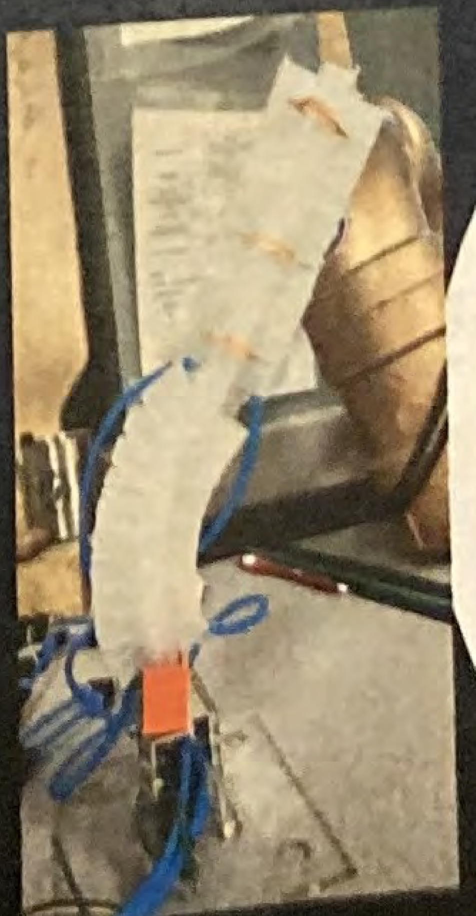
NASA HUNCH

High school students United with NASA to Create Hardware



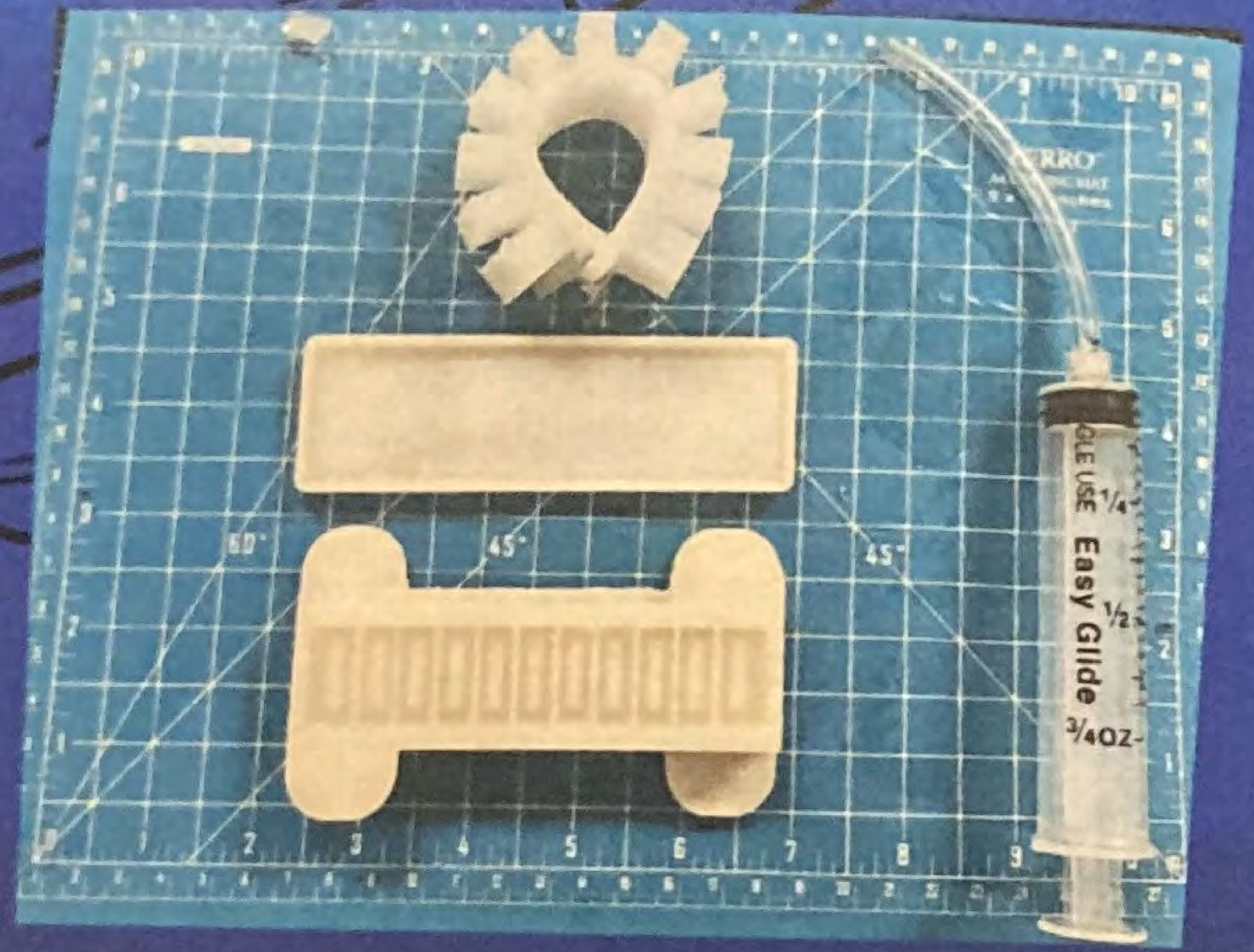
(Final Prototype)

The final prototype is made from four of the actuators placed onto a center silicone support. this will allow for complex movements



SOFT ARM

The actuator is made from A Vividye liquid silicone molding kit.



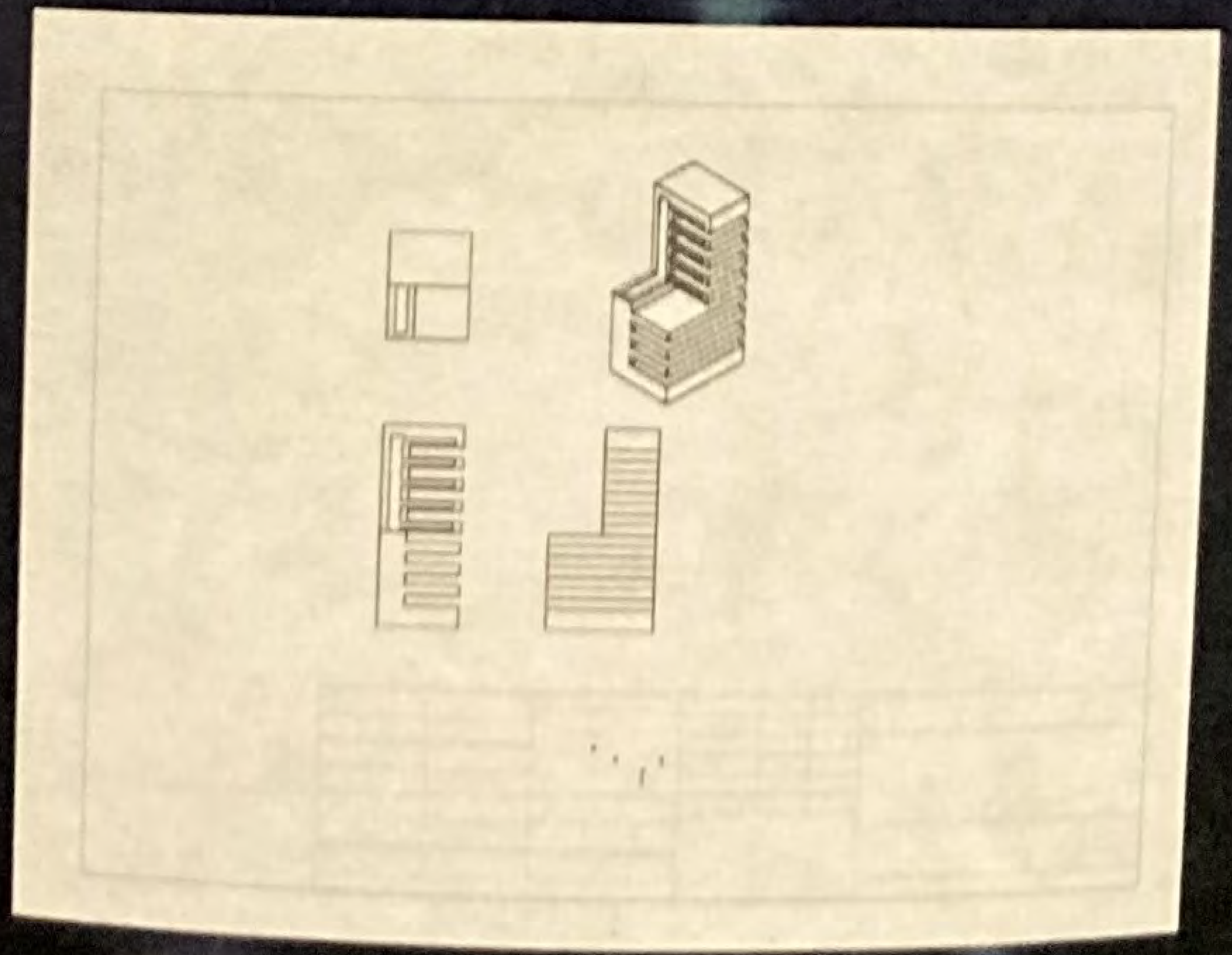
(The mold for the actuator alongside a molded actuator and syringe)

The actuator mold is a 3D printed part from Softrobotics.com. When air is added to the inside of the actuator the actuator will curl towards itself pushing or pulling anything it is attached to.

uses inspiration from an octopuses' tentacles. And the push and pulling motions of a tendon

(curling actuator due to air being added)

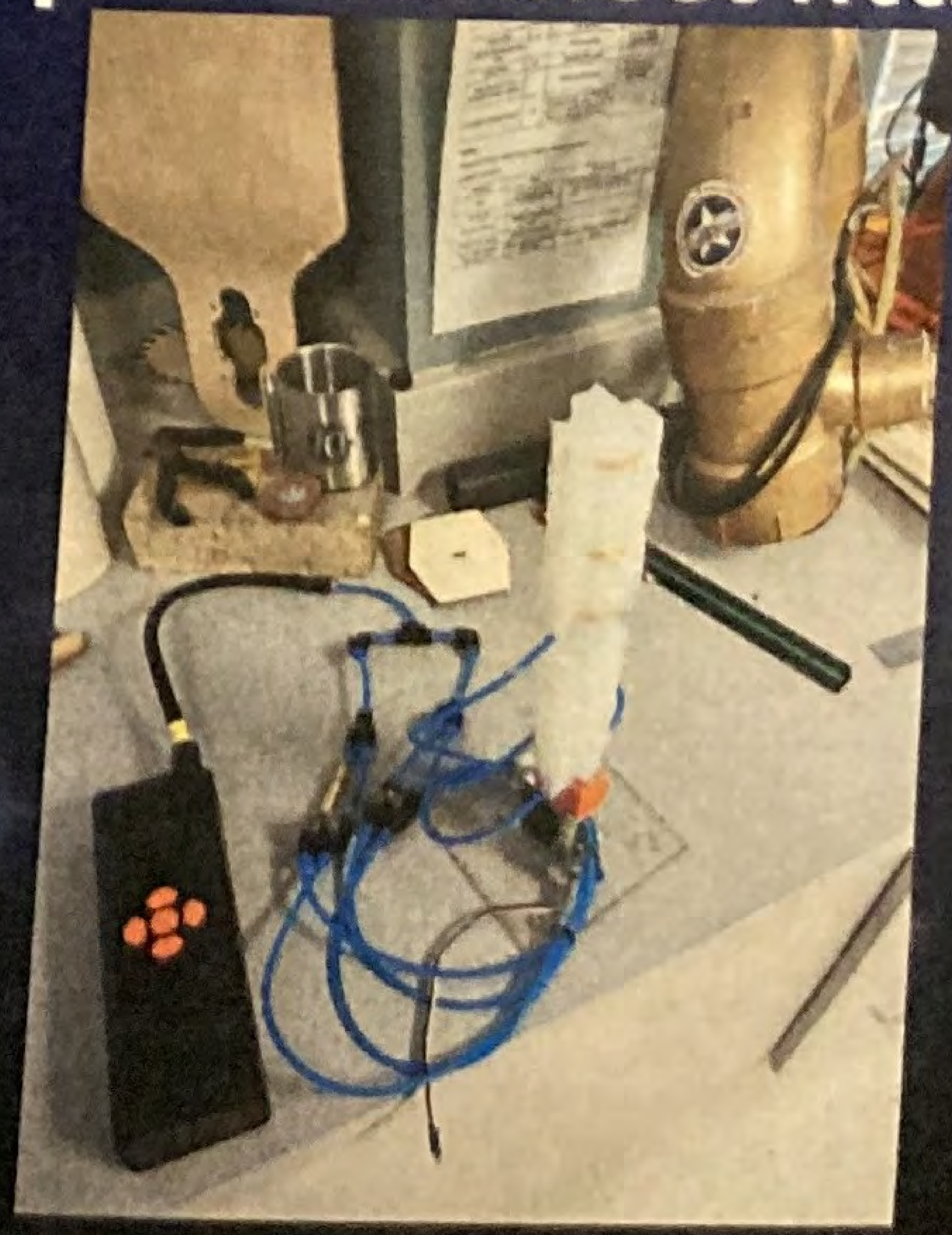
Compressed air will be selectively released into the actuator chambers to move the arm in the desired direction.



(Drawing of cross section of actuator)

(Pneumatic control system)

The arm is powered by a handheld travel wheel pump. This is connected to 4mm Tubing using quick connect fittings



(Pneumatic control system connected to the arm)

Animal Inspiration

Octopus Tentacles Elephant Trunks

The movement and design of both an octopus and an elephant's trunk are major inspirations of our mobility arm. Our arm mimics the rotational and longitudinal muscles to expand and contract the arm.

Designs Explained

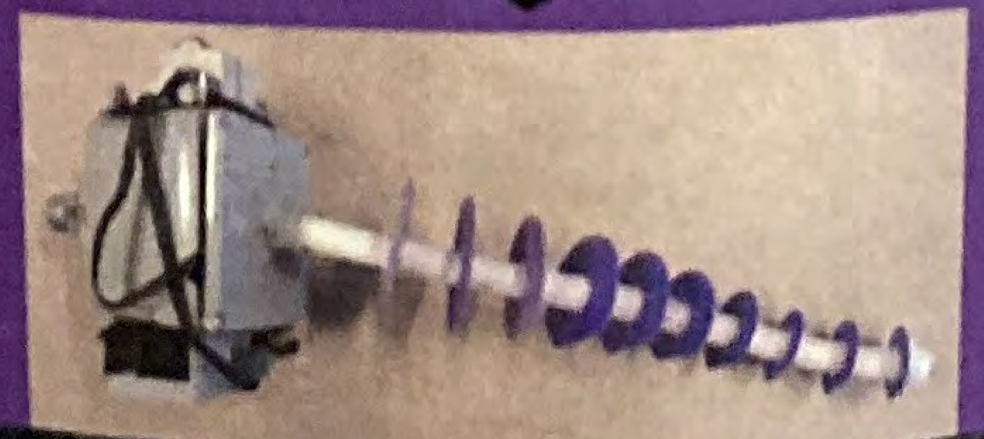
After the Mk1 Prototype we added a flat side to the MK2 prototype. This gave the MK2 a greater ability to conform to surfaces. The MK3 was a cardboard box designed to test the motor placement. Finally the MK4 is completely motorized and is rotatable.

Design Process

MK1

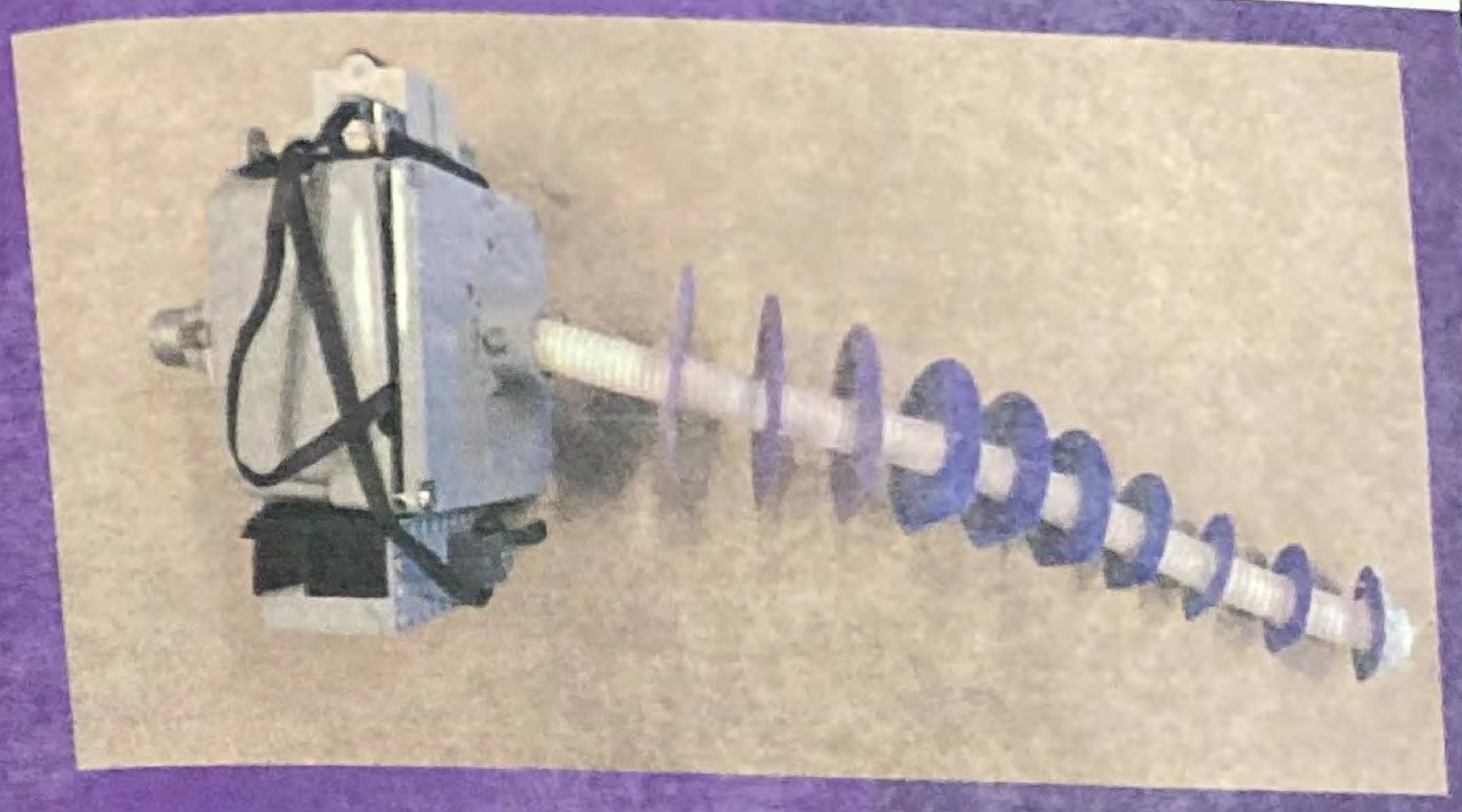
MK2

MK3



MK4

Current Prototype



Our current prototype upgraded materials from the first prototype and now includes: motors, a powered bearing and many other improvements

Improvements function

Cover Sleeve:

The cover sleeve will protect internal components from dust and foreign material

Powered Bearing:

Allows for a greater reach and range of the arm

Motors / Conduit Box:

Cut our projected 4 motors down to 3. 2 for the bending of the arm and 1 for the rotation. The conduit box contains all of the motors

M.A.R.S.

Mobility. Arm. Research. Students

Instructor: Fabian Brunetti
State: Colorado
School: Chatfield Senior High
2023-2024

Criteria & Constraints:

1.) Limited rigid parts
2.) Must be able to grab onto handrails and flat surfaces to move
3.) Extend and contract 12in
4.) Must be able to rotate and grasp in multiple directions

Why Us?

- We have integrated with the Chatfield Suction cup team S.U.C.C.
- Our design is intentionally made to be the best tool for the job but is simple and effective

Improvements / Additions

- Added a powered bearing
- Added a conduit box that houses the motors
- Added a cover sleeve
- Fishing line for cables
- 3D printed segments
- Fully motorized functionality
- Added a connection point (to attach arm / motor box to the central robot)

M.A.R.S. Team

Buck Tulloss

Raven McNamee

Katie Johnson

Lance Baron

We are four Chatfield Senior High School students making the mobility arm for the kwadrapus cleaning robot.

Contact Info:
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Buck Tulloss
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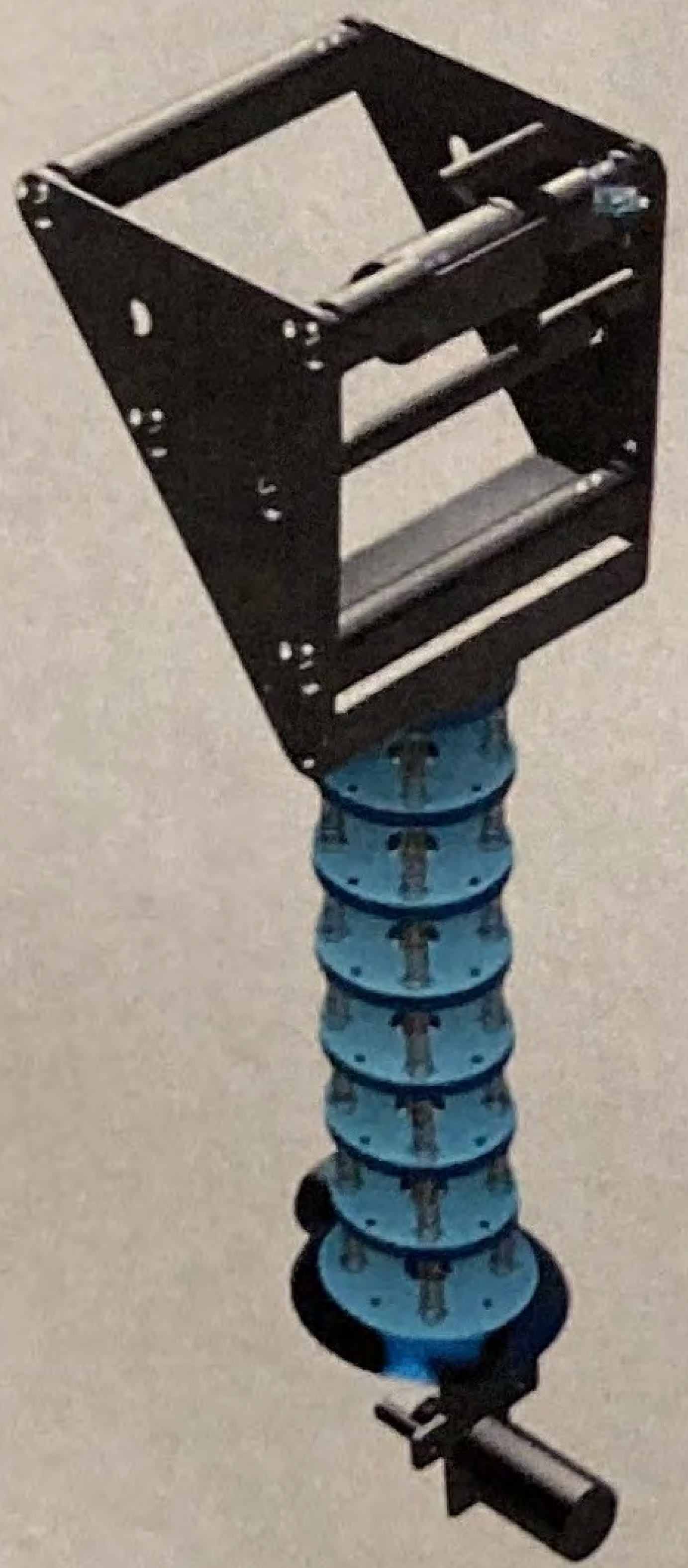
Lance Baron
2258735@jeffcoschools.us
Raven McNamee
2170228@jeffcoschools.us

KWADROPUS ROBOTIC DUSTER ARM

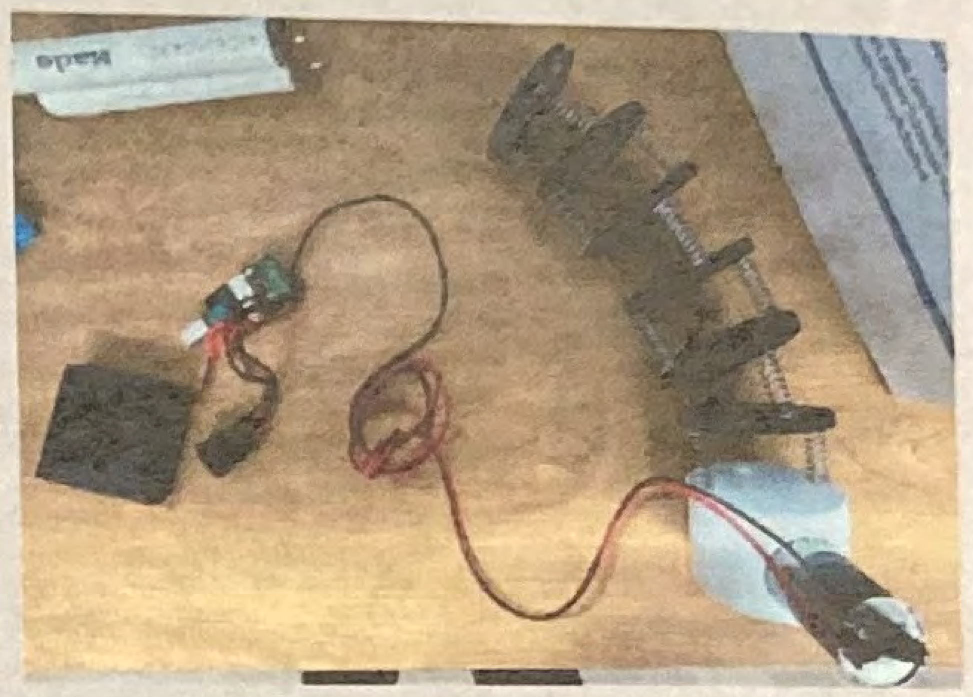
JACOB CASTRO
JOSEPH GOH
NAWAL SIDDIQUI



GOAL

Create a flexible robotic duster arm that collects human skin cells and hair follicles, food crumbs, and clothing lint efficiently in a micro-gravity environment while producing minimal waste.

VERSION 1



DESIGN

- 4 springs for stability and control over orientation.
- 2 motors for multi-axis rotation.
- Built-in brush for longer cleaning span.
- Microfiber for simple maintenance and minimum waste.
- Powerful DC motors will ensure effective performance.
- Removable belt will allow for easy cleaning with a vacuum.

FINAL PROTOTYPE

TESTING

BENDING

The arm successfully bends more than 90 degrees in each direction.

CLEANING

The belt duster design expands dust retention by creating more surface area.

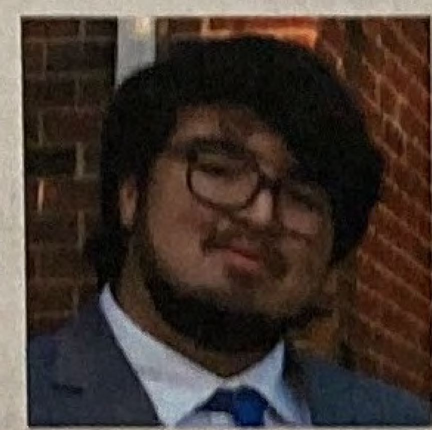
MICROFIBER

After 3 wipes the microfiber holds 70% of the starch and the brush removes 26% of it.

WEBSITE

THE TEAM

Plano ISD Academy High School
Ms. Gunnels
Grade 12



Jacob Castro
CAD Lead

Joseph Goh
Design Director

Nawal Siddiqui
Hardware and Software Manager

PROJECT PNEUMOTION

MOBILITY WITH A SOFT TOUCH.

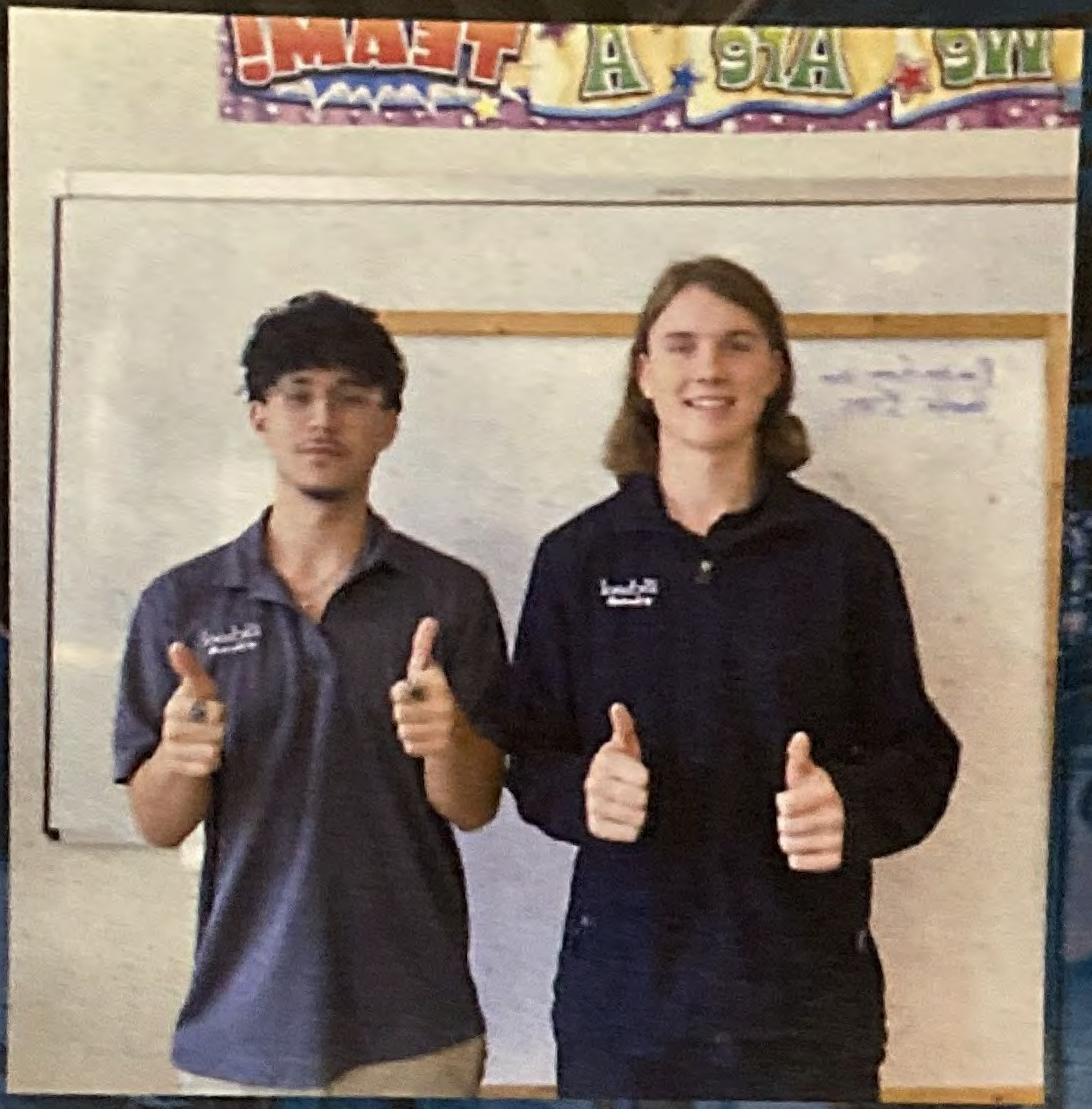
REVOLUTIONIZING SPACE STATION MAINTENANCE

THE ROBOTIC DUSTER MOBILITY ARM PROJECT ENTAILS THE DEVELOPMENT OF A SOFT ROBOTIC ARM, DRAWING INSPIRATION FROM THE CAPABILITIES OF OCTOPUSES, WITH A FOCUS ON MOBILITY WITHIN A SPACE STATION FOR THE ROOMBA LIKE DUSTER ROBOT.

THE FUTURE OF SPACE STATION MAINTENANCE WITH UNRIVALED MOBILITY.

IN THE CONFINED QUARTERS OF A SPACE STATION, PRECISION AND ADAPTABILITY ARE OF UTMOST IMPORTANCE. ENTER OUR REVOLUTIONARY PNEUMATIC MOBILITY ARM, A COMPONENT DESIGNED FOR A SPACE STATION DUSTER ROBOT. WITH A COMPACT FORM FACTOR AND UNPARALLELED MOBILITY, THIS SILICONE-BASED WONDER INCORPORATES 16 SEGMENTS OF HONEYCOMB STRUCTURE, ALIGNED FOR MAXIMUM FLEXIBILITY AND STRENGTH.

KWADROPUS - MOBILITY ARM

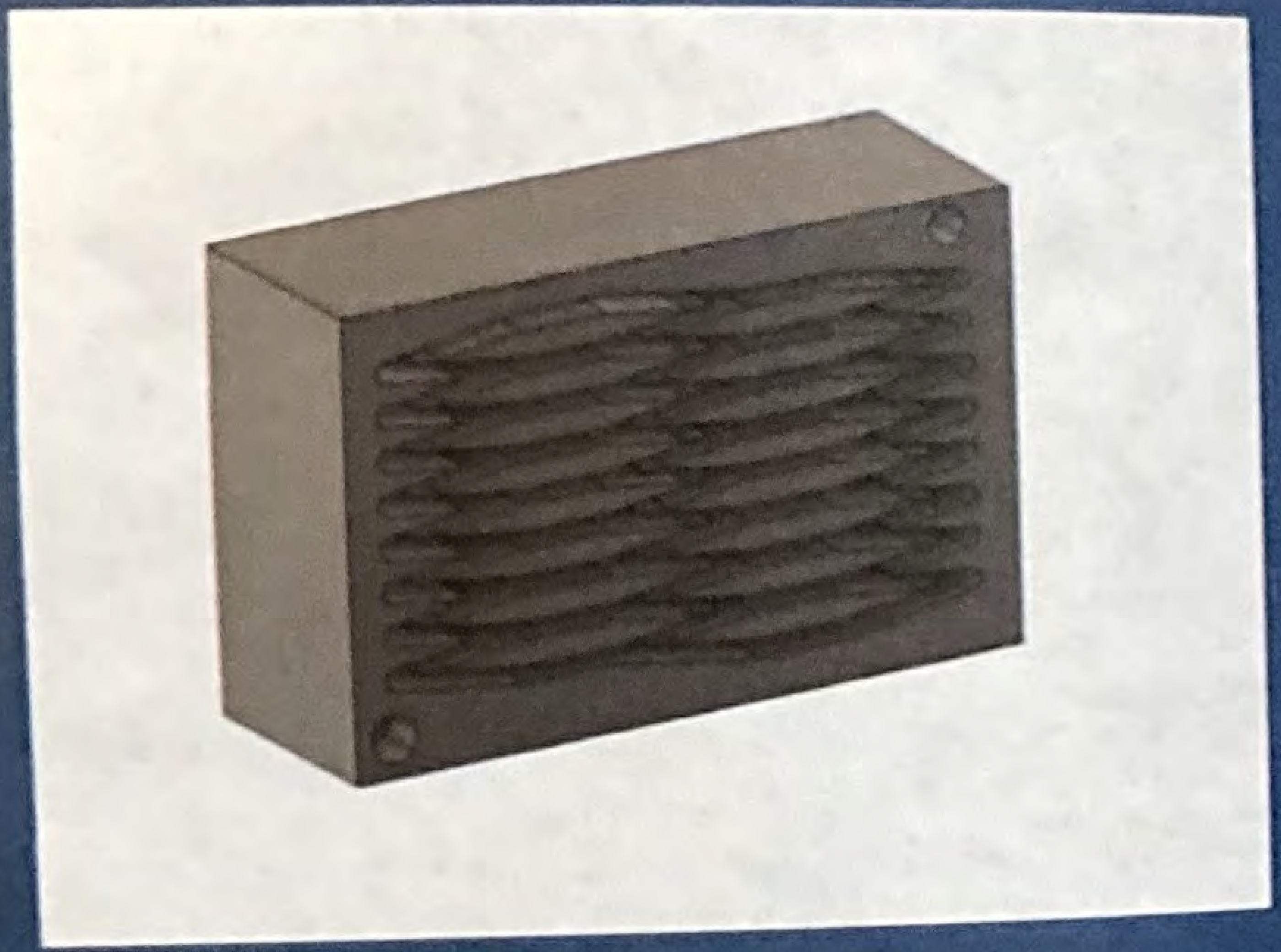


PROJECT PNEUMOTION

NASA HUNCH

OUR DESIGN STORYBOARD

1 CAD DRAWING



2 PROTOTYPE

PROGRAM - DESIGN AND PROTOTYPE

TEAM PROJECT PNEUMOTION
CHRISTIAN CASTANEDA & KOHEN SNYDER
LEWISVILLE SCHOOL OF SCIENCE
LEWISVILLE, TEXAS
N.A.S.A. H.U.N.C.H.
2023-2024

NEXT STEPS/ FUTURE PLANS

1

TEST RESULTS AND CONCLUSION

OUR RESULTS WERE A RESOUNDING SUCCESS AND WE WILL MOVE FORWARD WITH PHASE 2

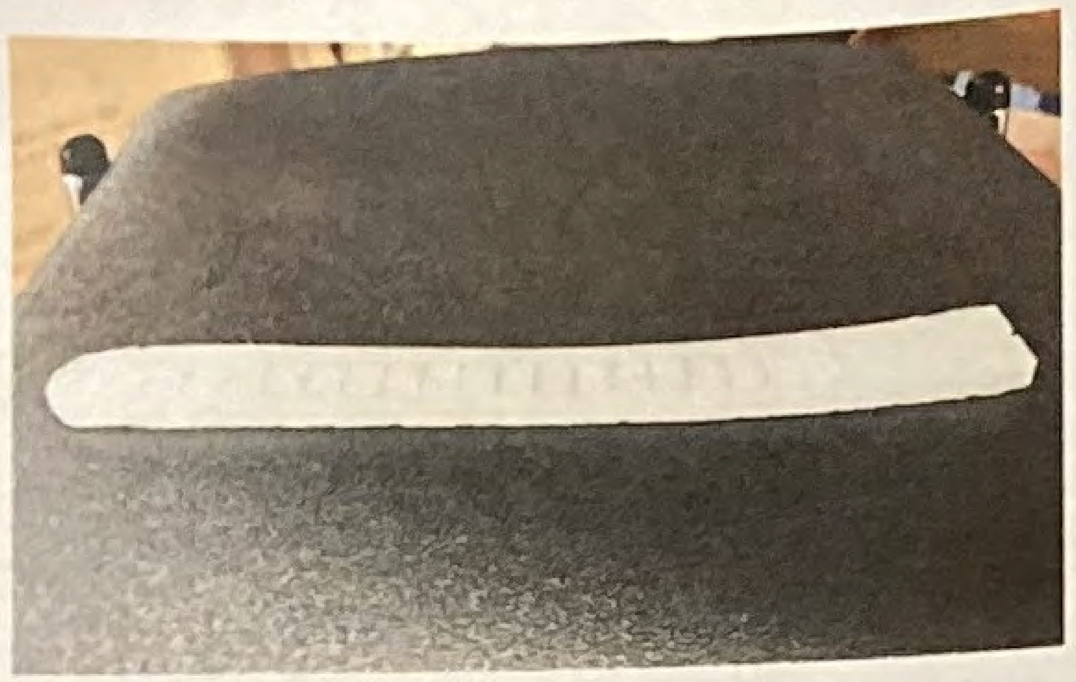
2

NEXT STEPS

START MASS PRODUCING OUR SEGMENTS WITH THE BUILT IN AIRBAGS AND FINISH UP ALL OF OUR CODE

FINAL STEP

OUR FINAL STEP WOULD BE TO FINISH ALL THREE SEGENTS OF THE ARM AND ATTACH THE GRIPPER TO THE TOP, PRESUMABLY WE WILL ALSO HAVE THE BUILT IN AIRBAGS IMPLIMENTED



Failed attempt

Problem Statement:

How will we Develop one robotic arm with minimal amount of rigid parts that can pull itself from one location to another using a handrail or other?

Important Questions:

What material should be used?

Will the air pressure in the arm work in space?

How can we rotate it?

Video Demonstration of Mobility arm in use

NASA HUNCH

MOBILITY ARM

BY

JOSHUA VAN WAGENER AND NICHOLAS ALLEN

FOR

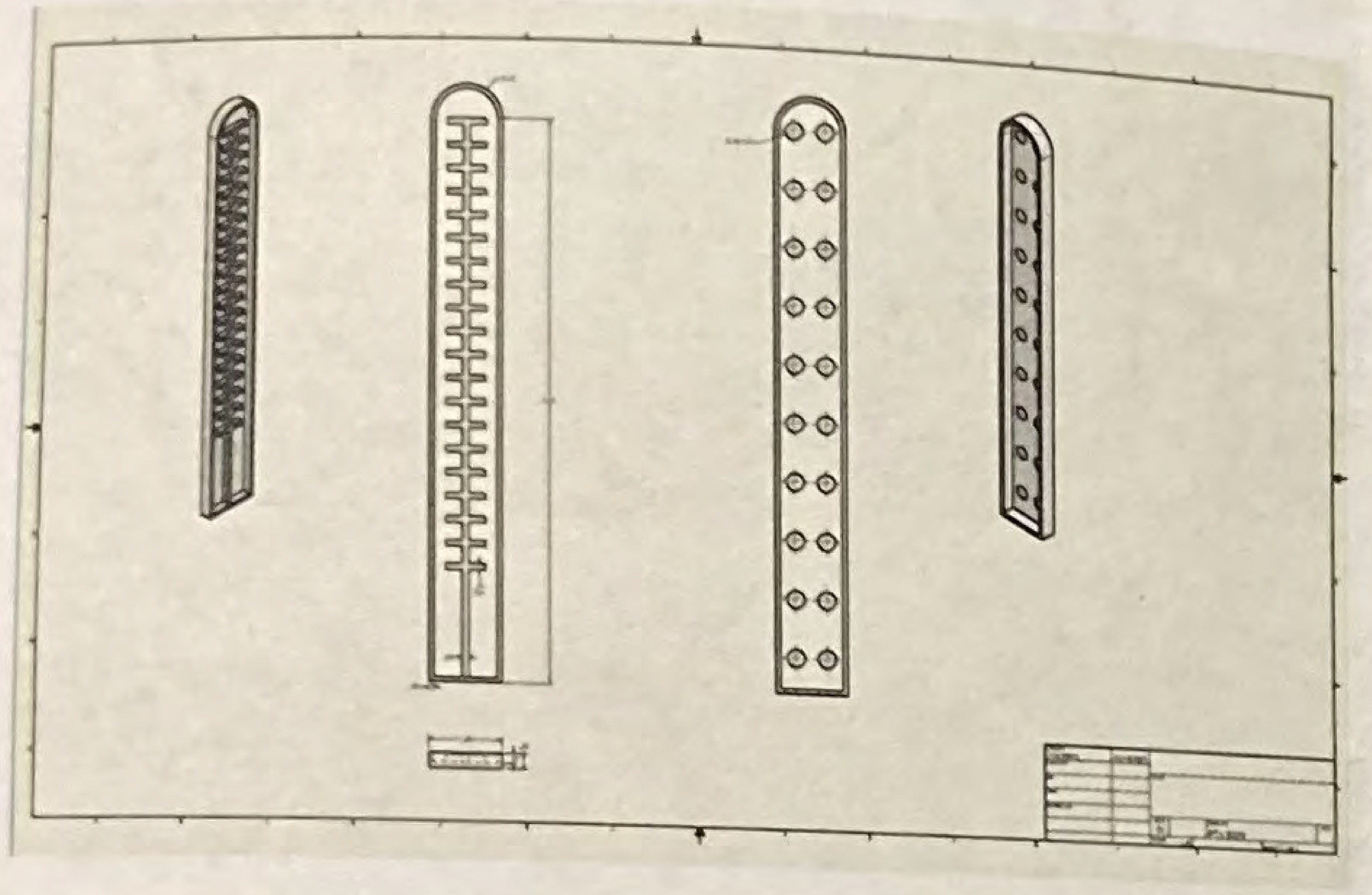
MR. ROBIN MERRITT

CIVIL ENGINEERING AND ARCHITECTURE

CLEAR CREEK HIGH SCHOOL

CLEAR CREEK ISD

LEAGUE CITY, TX 77573



Design – The Mold

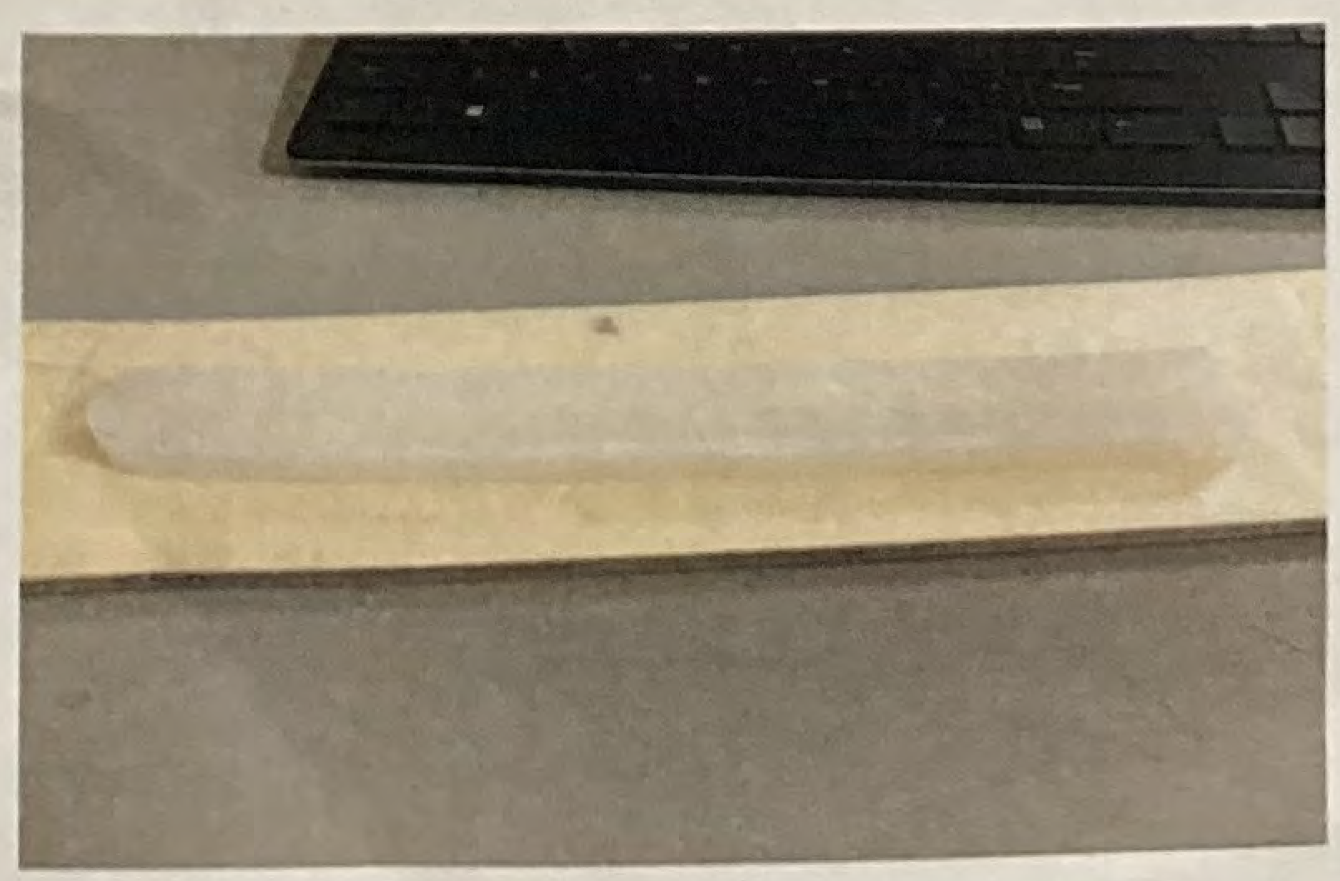
The mold images above are what we used to create the arm. The mold piece on the left of the picture is the most important. That piece allows for a specific flow air pressure to be pushed through the arm once it is sealed onto the other piece. This would ideally allow for the arm to bend inward onto itself and be able to pull the robot around through things like handrails. Once the arms are glued together, there will be one hole at the bottom for air to be pushed in.

The Mobility Arm

After laying the silicon mix and letting it sit overnight, The 2 pieces of the arm could be removed from the Mold. Our first iteration of the arm was too thick, Making the air pressure too weak to move it. However, we modified this mistake to make the Arm thinner and allow more air inside, making the Arm able to bend properly.

How does the air pressure work?

The arm, once put together, will have a thin side, and A thicker side. The thinner side will allow the arm to Be weaker against the air flow than that of the thicker Side. This will make the movement of the arm Possible since the weaker and thinner side of the Arm to bend while the other side maintains its Structure.



Our Process

Before we began our project, we did as much research as possible about what we could use to make the arm. Our first inspiration was a video we found online which used a silicon material to make an arm.

We modified the idea of a 3-way "hand" from the video to one extended arm built the same way each "finger" was built in the video. This would function by curling in on itself after grabbing onto something, pulling the root around as a result.

About Us

Joshua Van Wagener – Senior

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Nicholas Allen – Junior

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RYAN MESSNER

CONTACT INFO:
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NASA HUNCH

ABOUT US

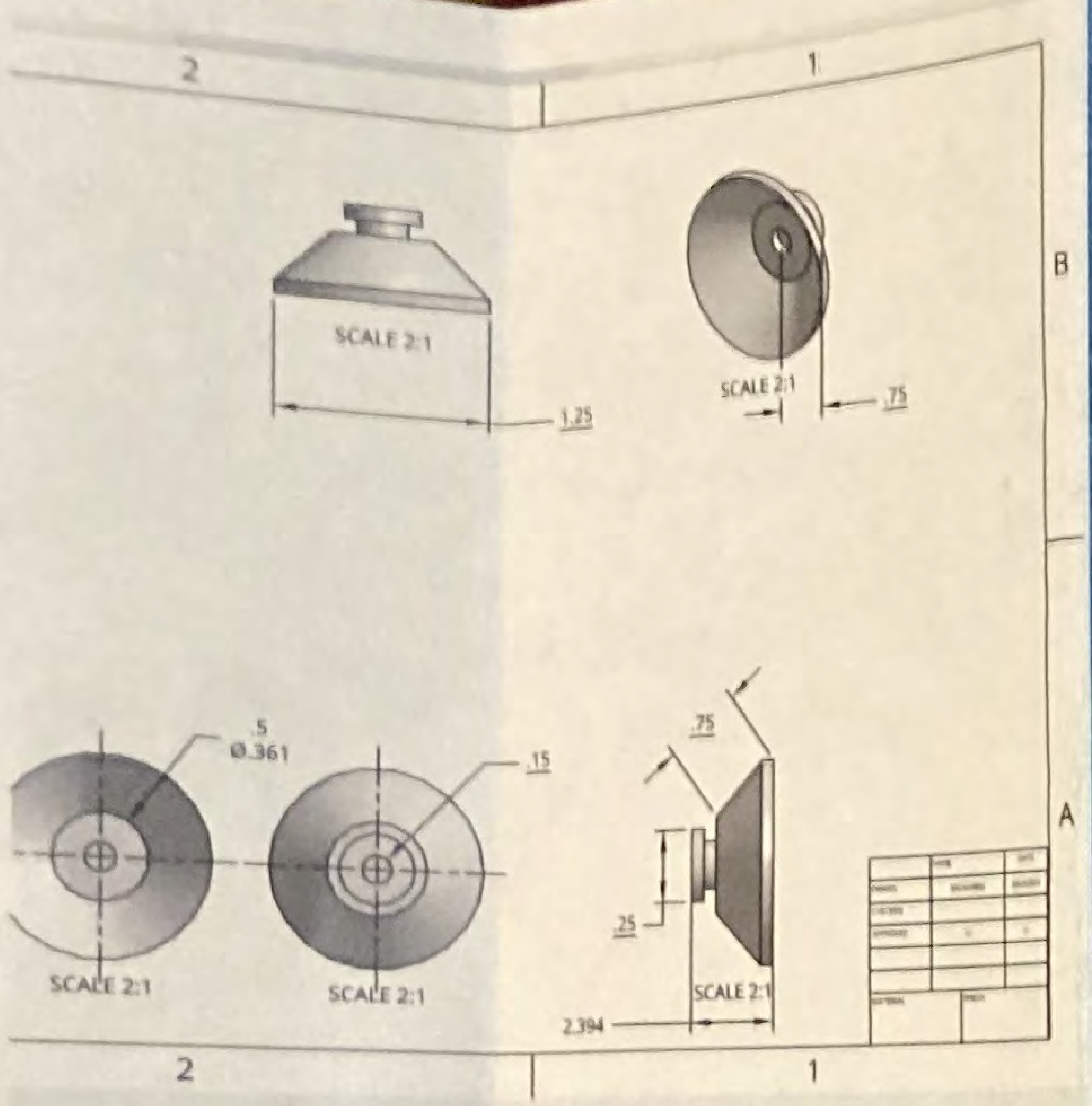
Welcome to Wave Mobility, where innovation and inspiration meld together. It is a group of two driven by the vision of improving mobility through the octopus-inspired arm with a wave-like motion. Through design and construction, we, as a team, craft solutions to promote movement variations. Through our exciting journey, we make the world of mobility in our project the best it can be.

ADDITIONAL INFO:

High School: Shakopee Senior High
Instructor: Mr. Hendrickson

WAVE MOBILITY

NASA HUNCH
Mobility Arm Project



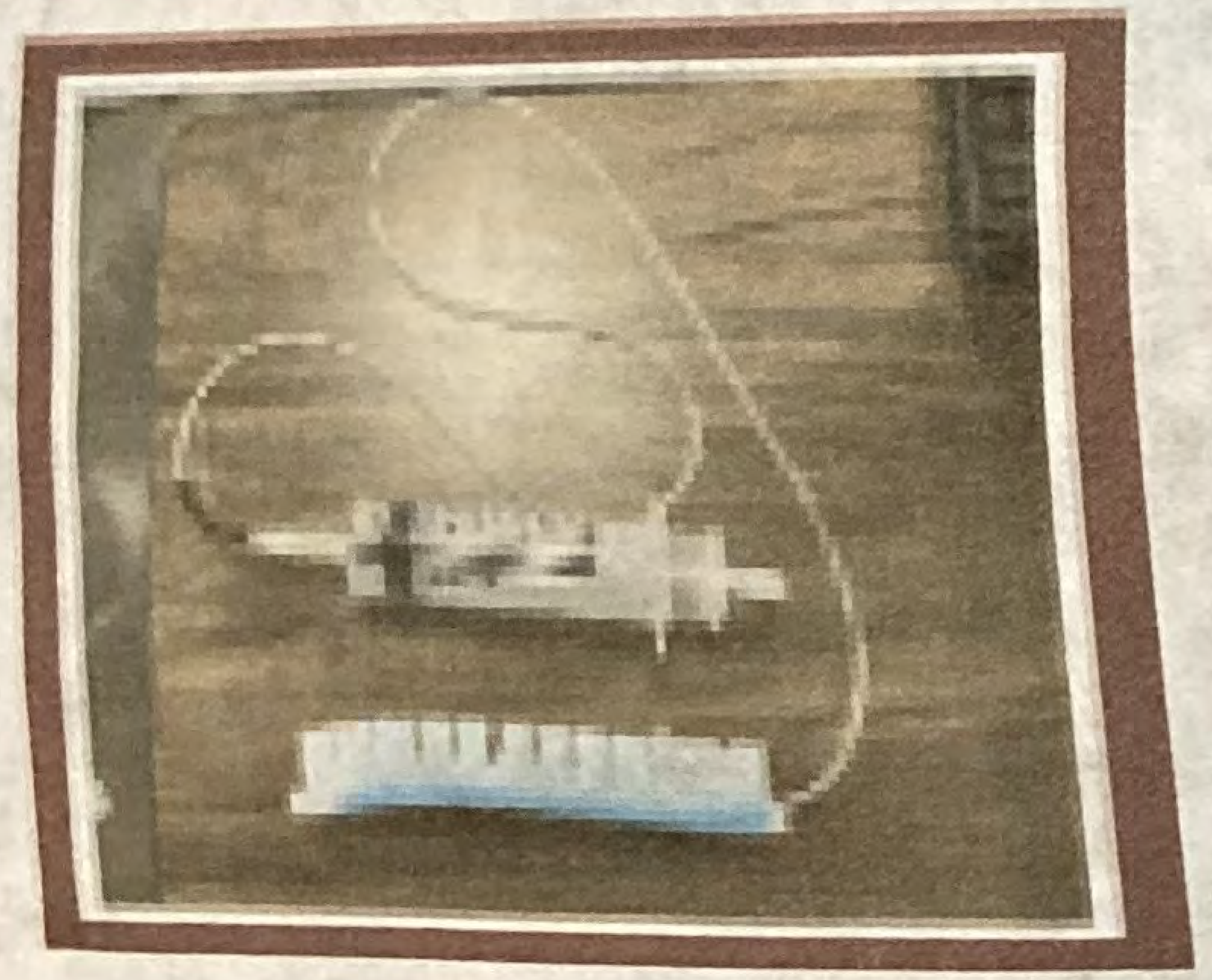
SUCTION CUP DESIGN

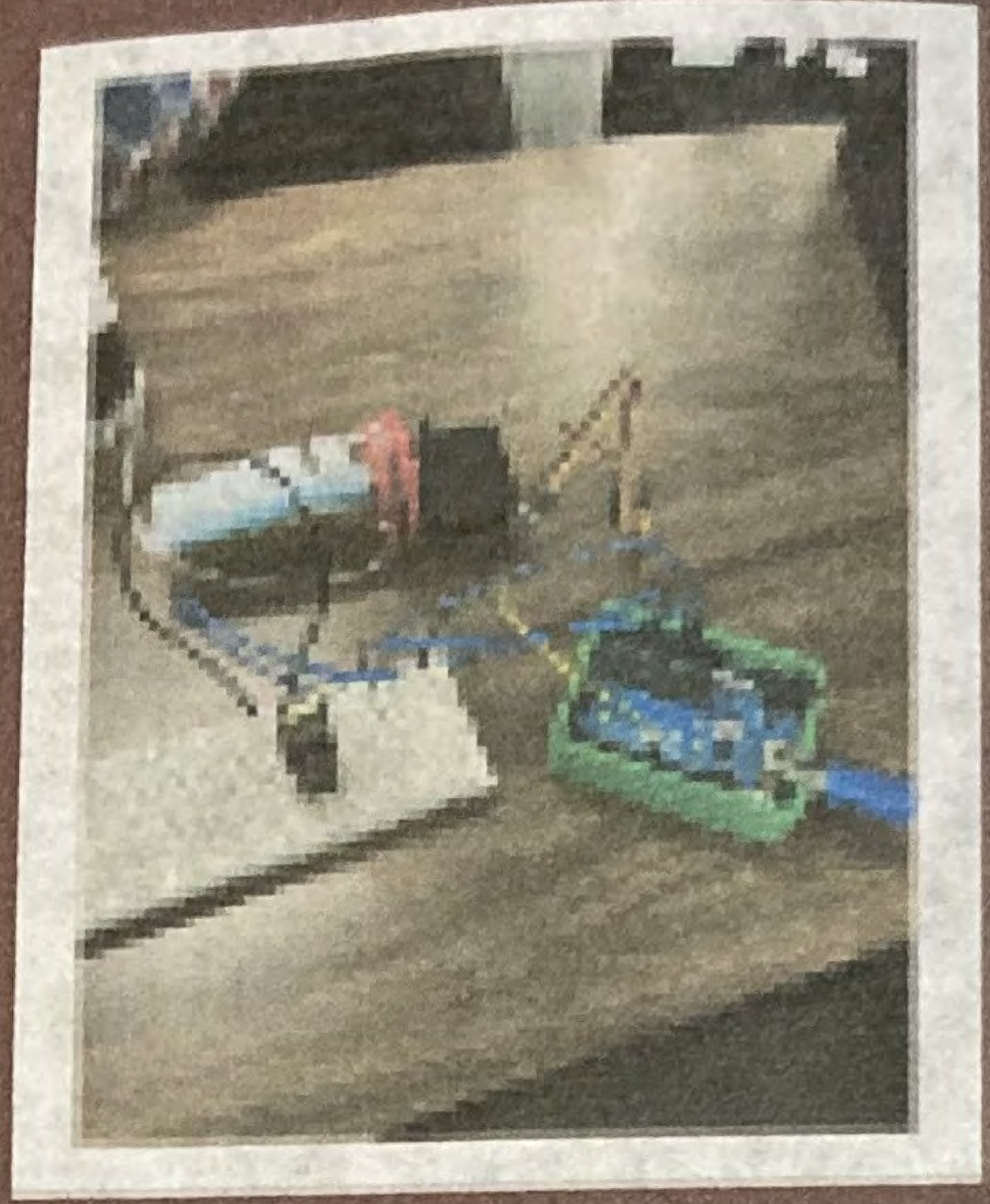
OUR ROBOTIC OCTOPUS ARM ADAPTS TO DIFFERENT DISTANCES AND SURFACES, FEATURING ADVANCED GRIPPING MECHANISMS AND SPECIALIZED SUCTIONS FOR ENHANCED PRECISION. MADE AND CRAFTED WITH APPLICABLE PRECISION, THE ARM ENSURES A SECURE GRIP IN ALL DIRECTIONS. NOTABLY, EACH COMPONENT OPERATES SMOOTHLY, AND THE ARM EFFORTLESSLY FOLDS INTO ITS STRUCTURE WHEN THE STRINGS ARE CORRECTLY TENSIONED, SIMPLIFYING OPERATION FOR OPTIMAL EFFICIENCY. WELCOME TO A NEW ERA OF ROBOTIC INNOVATION, WAVE MOBILITY.

The Robotic Octopus Arm is a creation that operates using an intricate system of disks, strings, springs, and tubing, permitting the arm to bend seamlessly in all directions, imitating the natural dexterity of an octopus. With its design for precise object manipulation, our robotic arm allows for a flexible and functional mobility arm.

Old Prototypes

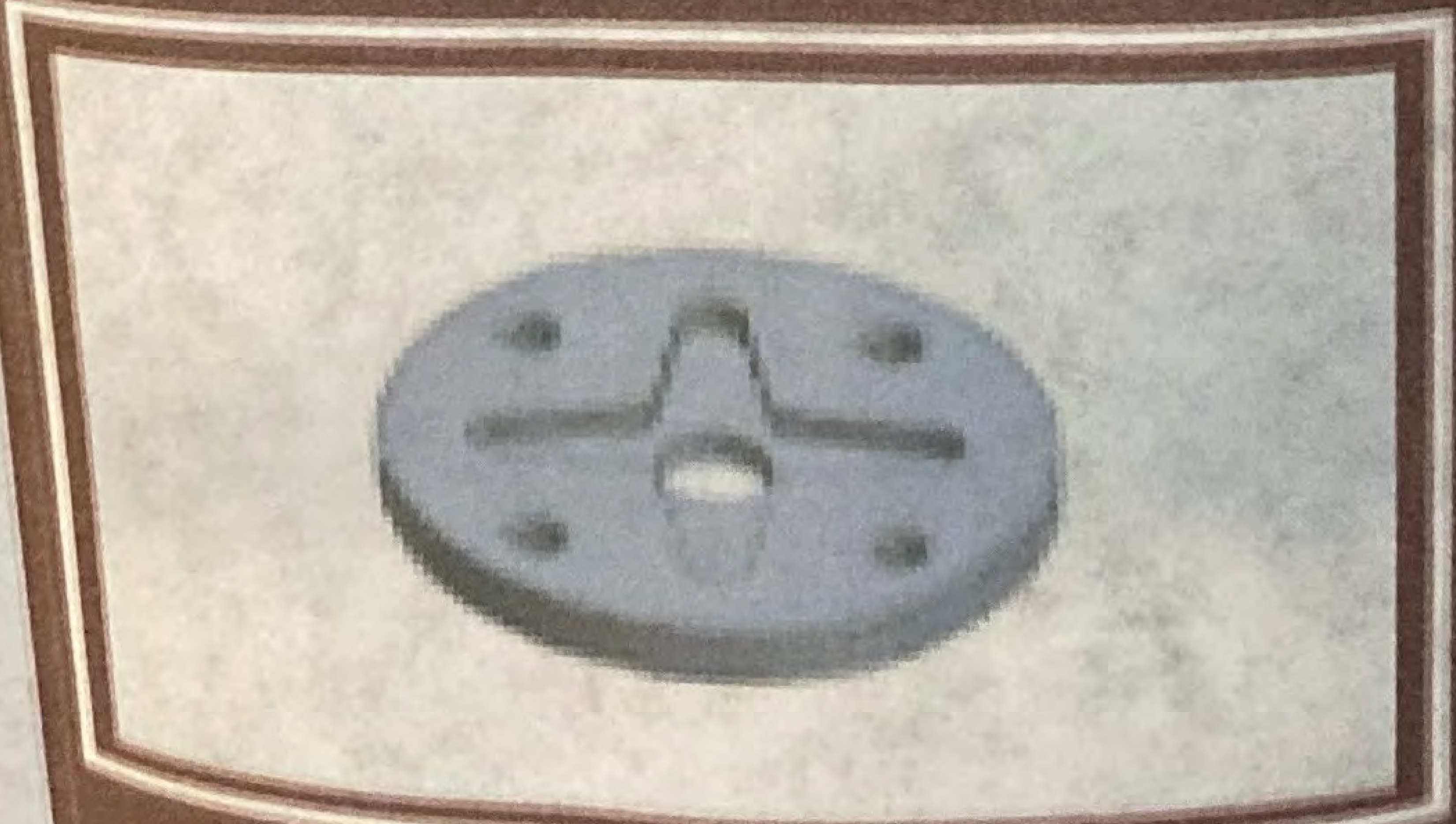
Our first prototype consisted of a soft flexible material that includes rubber and silicone called Ecoflex that represents the body. The body is attached to a syringe and there is an open cavity for air to go into. The design consists of segmented Ecoflex that bends with the addition of air pressure (syringe).





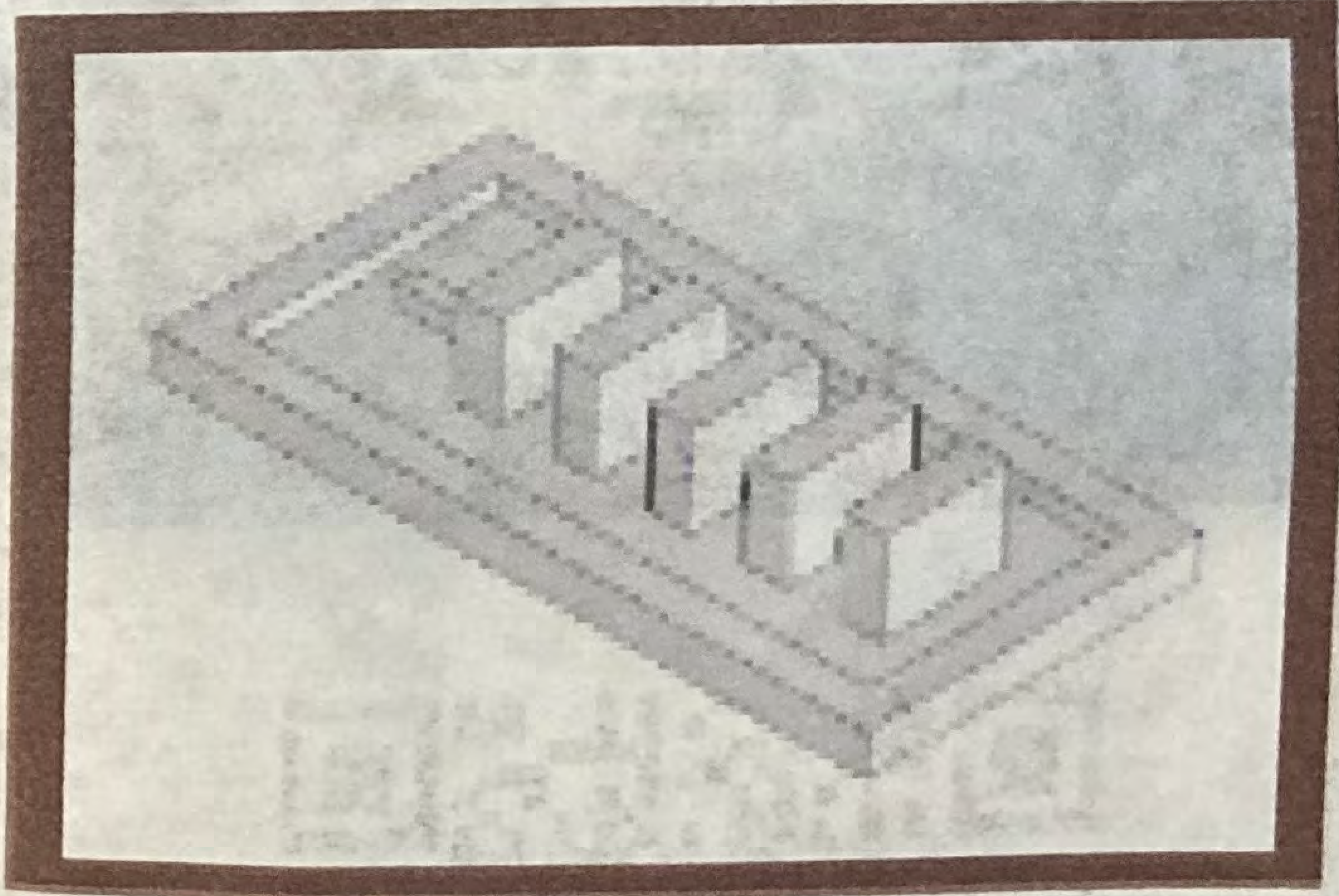
Wiring and Motor

A Servo motor is used to rotate the arm in 180 degrees, so the arm is able to grasp from different angles. Two 3D-printed plates are connected to the first arm segment and Servo motor which helps the arm stay constricted but efficient in its movements. Also, the two plates are connected through screws.



New Prototypes

With our new prototypes, we created 3D CAD models that were printed out on PLA to use as molds, as they were reusable and the most accurate to use with the Ecoflex. We started out doing small test runs with shortened versions of our goal. Each time we changed the way that the silicone was poured, or how the silicone part would be removed. So far it has taken over 8 iterations, and we get closer to the functionality that was represented with the original cardboard mold.



CHRISTIAN HIGH SCHOOL

Kwadropus Mobility Arm

Southwest Christian High School

Mr. Gary Shelton

Amanda Long, Nora Ganske, Julie Frahm, Kaitlyn Wercinski

Our Purpose

Our purpose for the Kwadropus Mobility Arm is for it to be able to extend, grasp, contract, and rotate to attach to a handrail in zero-gravity. The arm is made from silicone and attached to a 3D printed plate and servo motor that assists in the rotation of the arm.

The Prototype

Test Results

could not test do to improper seals

NASA HUNCH

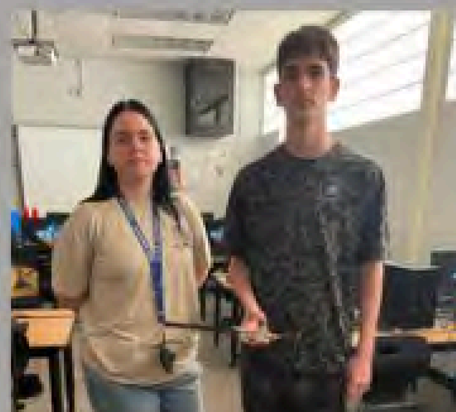
2023-2024

Kwadropus Propulsion Project

Palm Bay Magnet High School

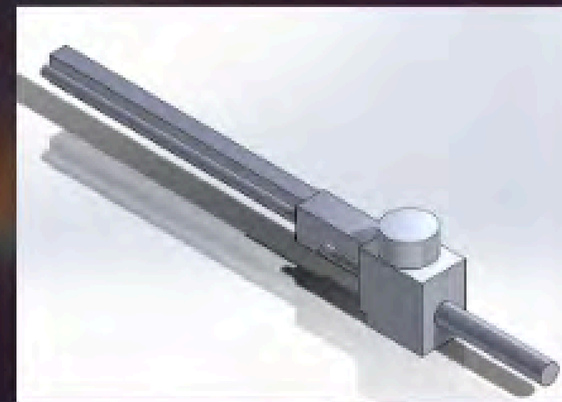
Mrs. Allen

Elise Wendt and Tyler Adamec



We were challenged to design a propulsion prototype to aid NASA in keeping the International Space Station clean.

CAD Drawing



About The Design

Similar to an octopus, a snake has the same type of movement with its body and by having an independent moving body they can twist in any direction making it a great body to hold compressed air so you can shoot compressed air in any direction to move the robot vacuum out of any place

NASA Hunch

Kwadropus Duster

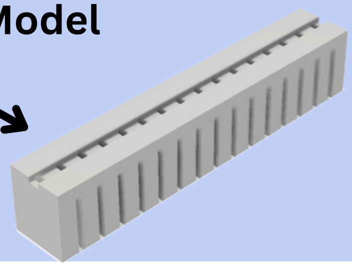
Robot - Mobility Arm

Madeline Ampleman, Alayna Beck, Miles Cohen, and Samuel Wilson

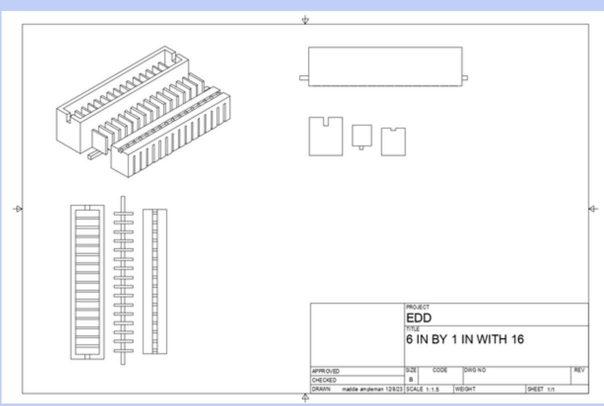
School: SMSD Center of Academic Achievement

Teacher: Renee Chambers

Fusion Model



Fusion Mold



Description:

The arm is equipped with a 12-inch tall pneumatic actuator for precise and versatile movements. Its base seamlessly integrates with a servo motor, enabling effortless multi-directional control. The innovative bending mechanism relies on a 500ml syringe filled with water, providing adaptability and fluid motion. It works by utilizing water pressure to stretch the silicone structure. The stress forces the whole design to actuate. The soft silicone material allows it to bend and conform around any shape.

Link to Video Pictures and documentation