The Team

Billings Career Center

JA-MO-BS

Joseph, Mathias, & Brevin

FAQ

What is our Final Concept?

Mathias: A magnetic ballast system that uses a magnet being pushed by electromagnets to generate force to propel the robot forwards or backwards.

How Did We Come to This Concept?

Brevin: We came to this method, because of the ingenuity the system has. It eliminates the need for a fan, whilst being a more uniform method of propulsion without inducing torque spin, and thus being more accurate. Along with less wasted energy.

Why Are We Pioneering This Method?

Joseph: I believe we are building this method of propulsion because it is out of the box. We are not taking the provided route, but rather one that competes with those set recommendations. Why would we do hunch if we didn't generate new, viable ideas?

Initial Test

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Magnetically Accelerated Propulsion System

M.A.P.S.

Final Design

Three Critical Components

-Ballast Housing-

-Striker-

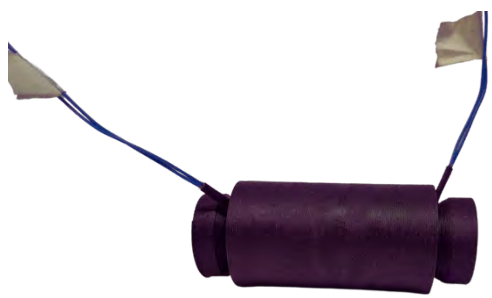
-Electromagnets-

Why this works:

It has been proven that ejecting/throwing mass from an object in microgravity will move said object in the opposite direction. So we capitalized on it.

Our prototype "throws" the mass of the striker in the housing using two electromagnets, this gives us the propulsion we seek.

Final Prototype



Designing

Initial Ideas

-Solenoid and Ballast Propulsion-

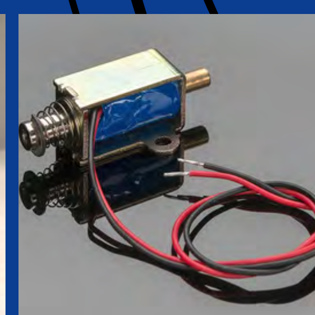
-Toroidal Propeller propulsion-

-Electro Magnetic Propulsion-

Toroidal Propeller

Magnets Vs Solenoids

-Magnets-	-Solenoids-
-Stronger-	-Weaker-
-Easier to-incorporate.	-Harder to design-with.
-Simpler-	-More moving-parts.
-Less moving parts-	

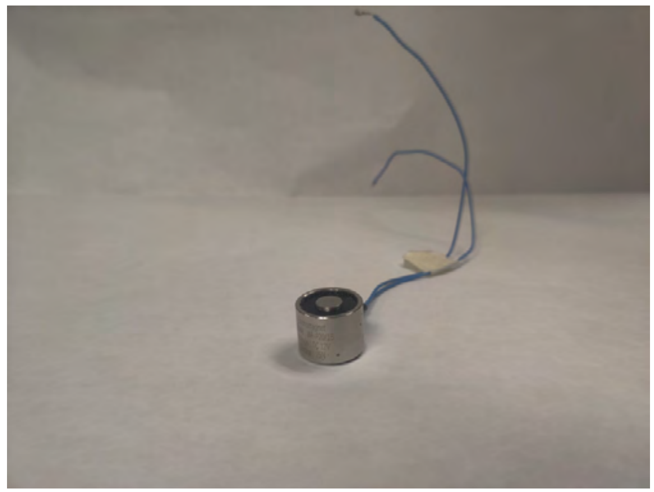


Eric Anderson's
Aerospace Engineering Class

BILLINGS
CAREER CENTER

Constructing The Prototype

With all prototypes there is a construction phase. In this process, we chose to print with PLA (Polylactic Acid). However, it can be constructed with metal and other 3D printed filaments



Our electromagnets turned out to be strong, however, they have a smaller magnetic field, so our design was adjusted for this issue.

The design length, electromagnets, and striker, can all be altered by NASA to suit their needs. The goal of our prototype is to prove that this form of propulsion is viable.

M.A.P.S

Magnetically Accelerated Propulsion System

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NASA
HUNCH

PROPULSION TEAM

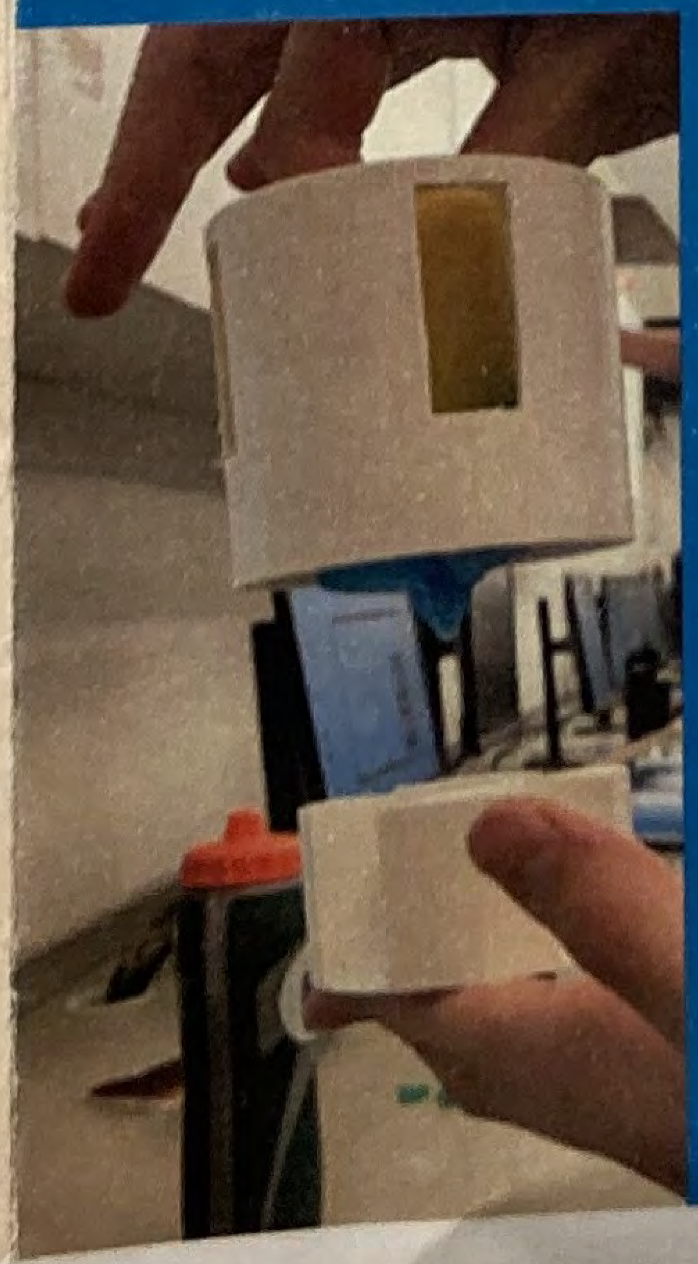
Problem Statement: Dust has become a problem on the ISS space station and a duster robot is the way it is being solved, but this robot may lose contact with a surface in which it can push off of, leaving it floating, unable to do anything.

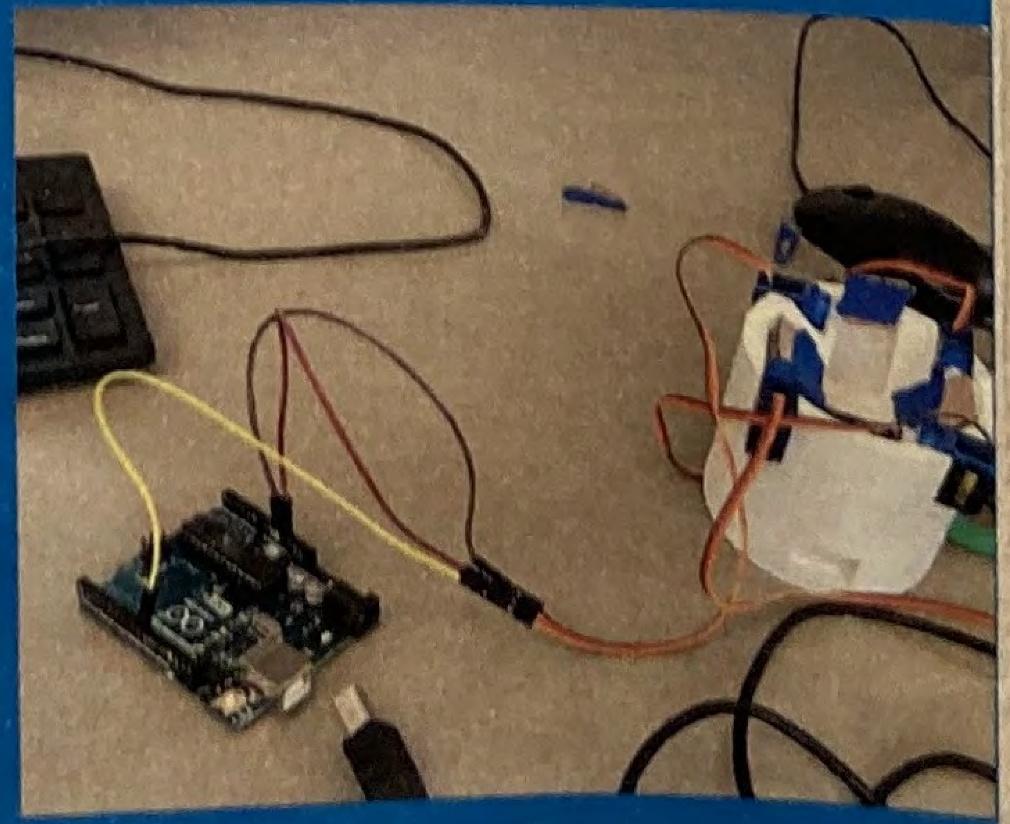
Our Project: A propulsion system that will propel the robot in multiple directions in order to allow the duster robot to reach dusty surfaces on the ISS

OUR SOLUTION

- A propulsion system that includes:

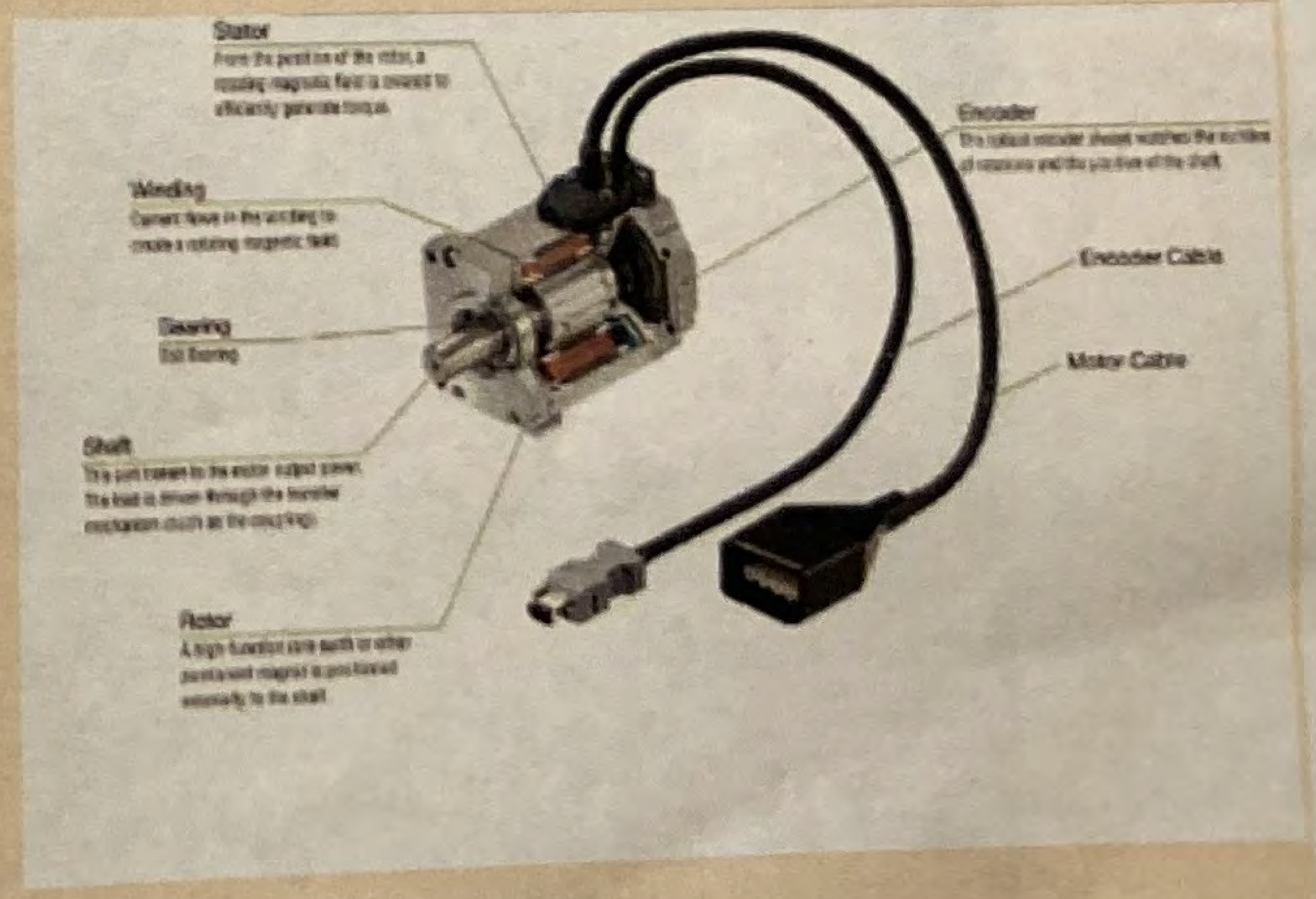
1. A 2.5 inch (diameter) propeller.
2. Air vent system for entry and exit
3. 9V DC Motor
4. 4-optimized servo motors controlling air entry and exit.





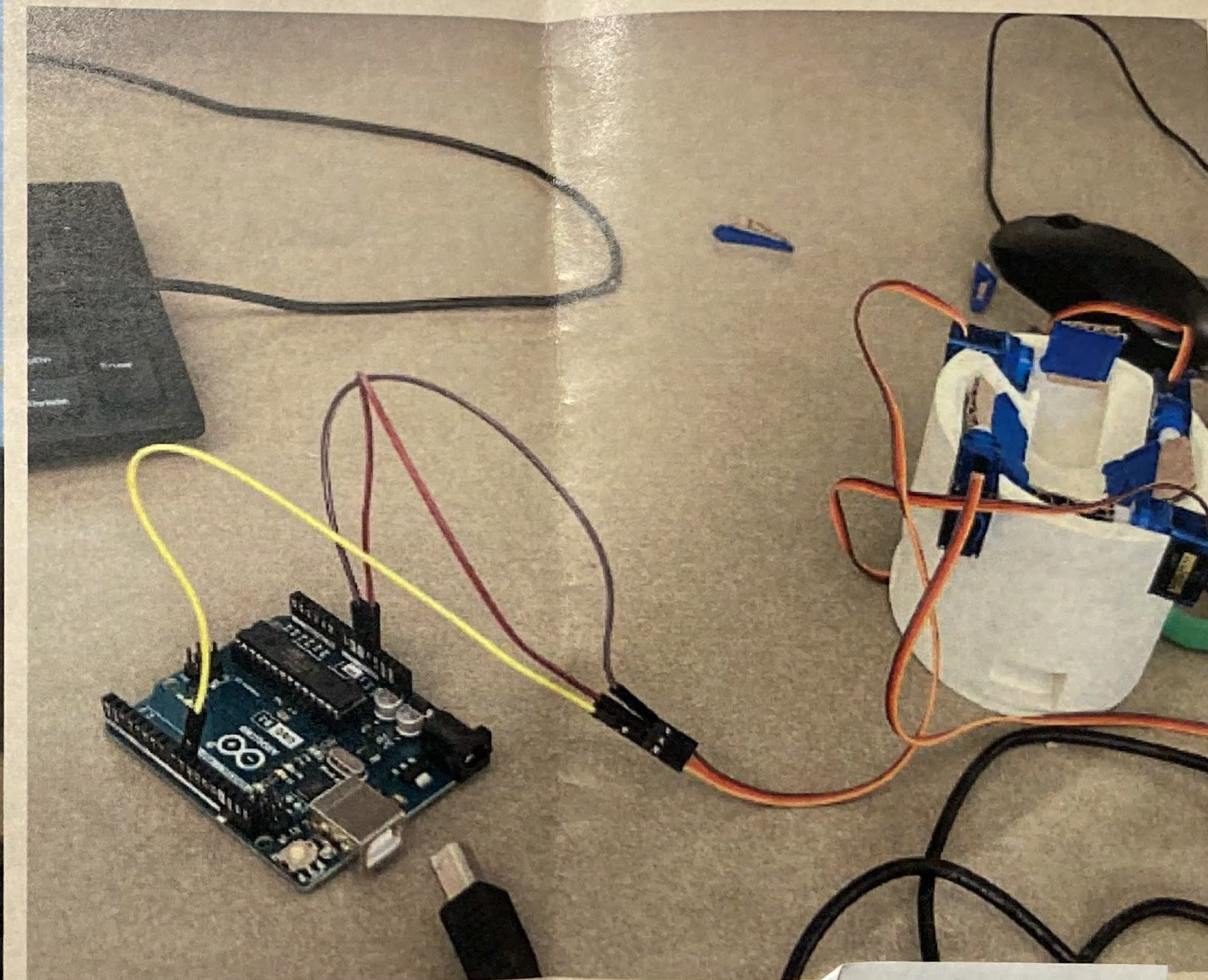
FUTURE IDEAS

- Carbon Fiber
- Smaller Servo Motors
- More powerful rotational motor



Vivek Khan
Nicholas Fry
Rylan Middaugh

Lakewood High School, Colorado 80215



OUR TEAM

CHARLES LIGHTHALL

MUNACHIMSO ANUEYIAGU

THANK YOU

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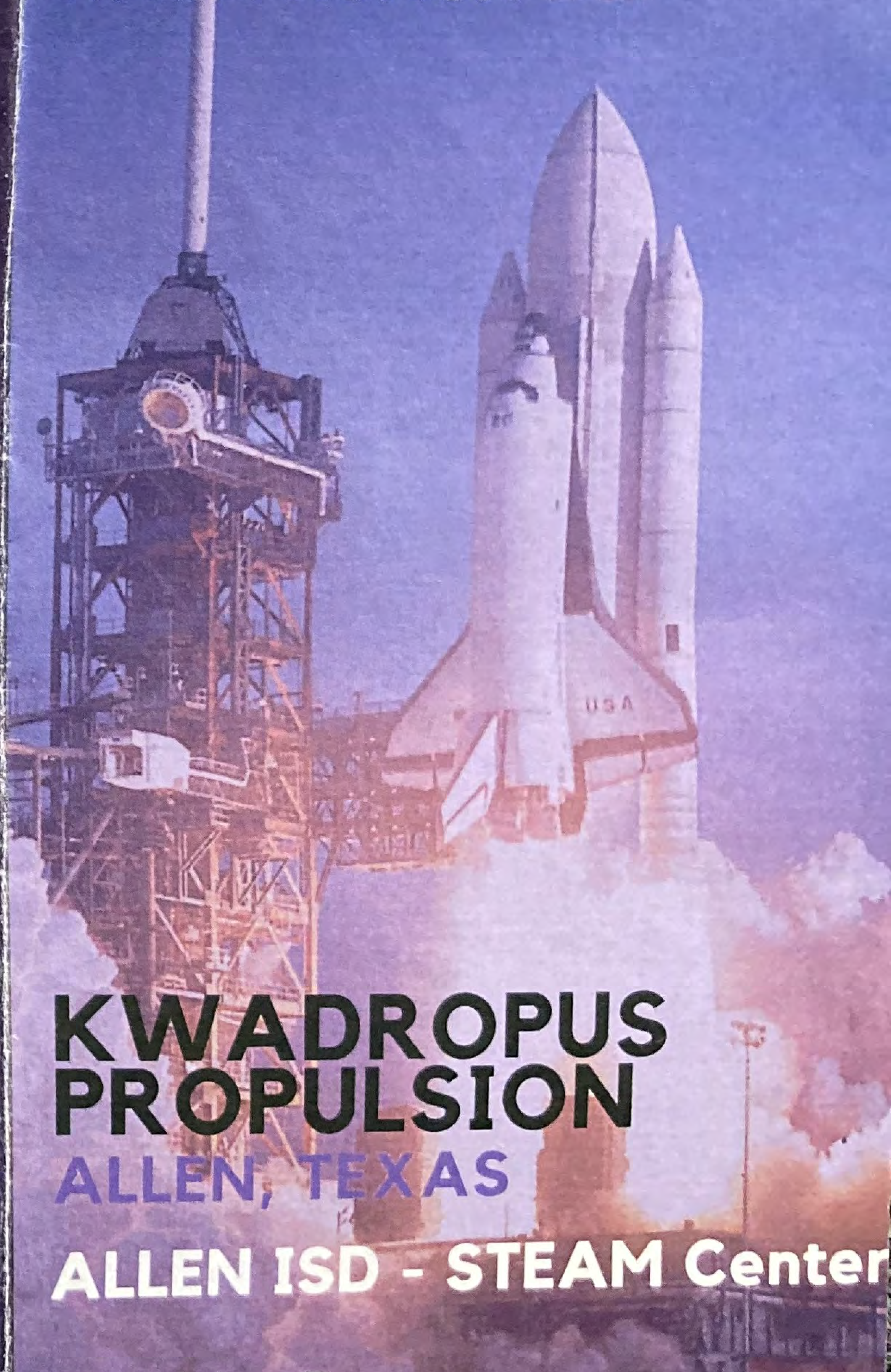
impulsus *

NASA HUNCH D&P



KWADROPUS PROPULSION

ALLEN, TEXAS

ALLEN ISD - STEAM Center

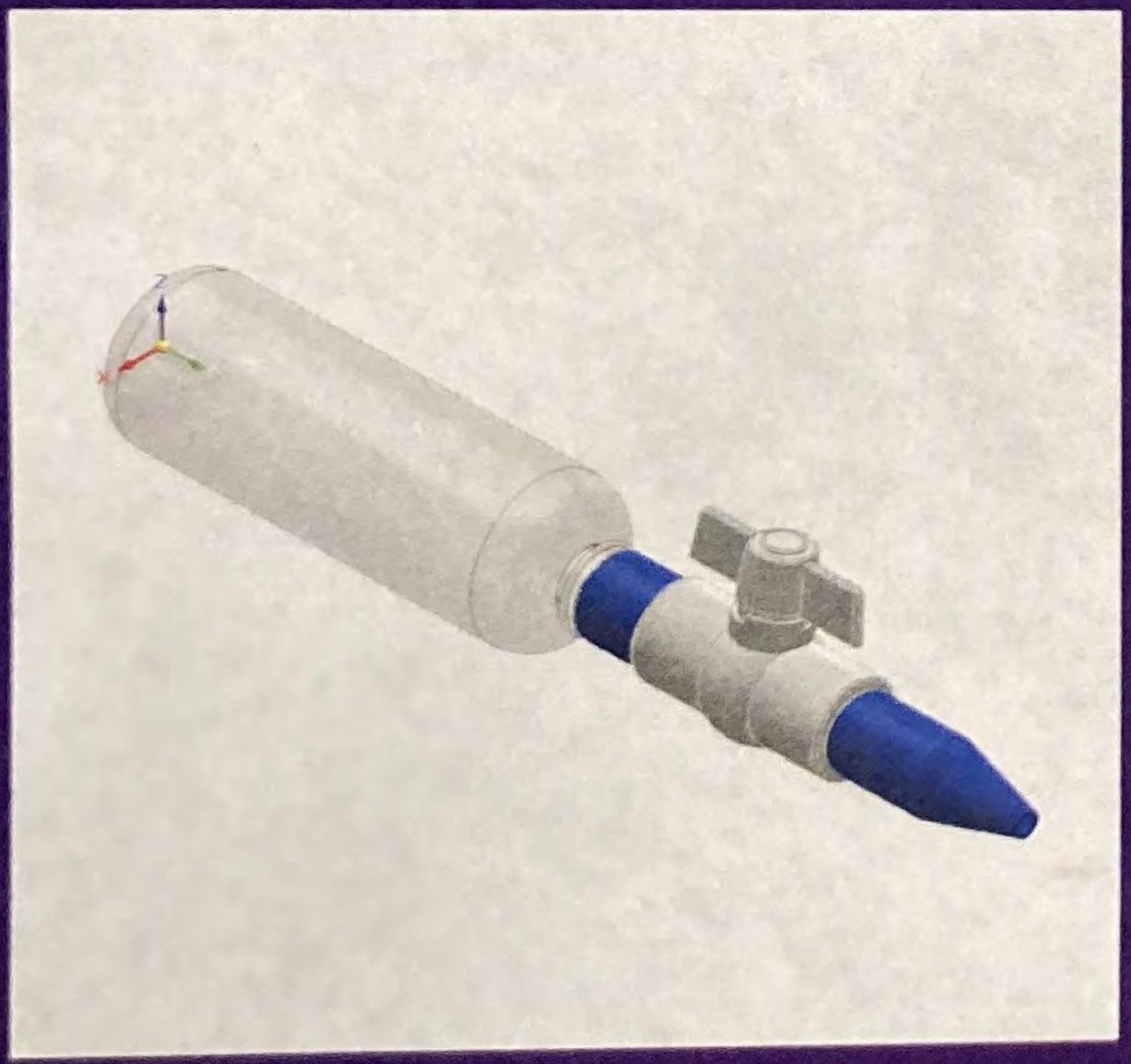
TEAM #5

MUNACHIMSO ANUEYIAGU CHARLES LIGHTHALL

SCOPE

IF AND WHEN ALL ARMS OF THE KWADROPUS LOSE CONTACT WITH THE WALL IT WOULD FLOAT TO THE CENTER OF THE MODULE. THE ROBOT WOULD NEED TO PUSH ITSELF BACK TO THE WALL TO REATTACH ITSELF. OUR GROUP'S TASK IS TO DESIGN A PROPULSION SYSTEM THAT WOULD HELP THE KWADROPUS MANEUVER AROUND

PROTOTYPE



3D - MODEL OF OUR DESIGN

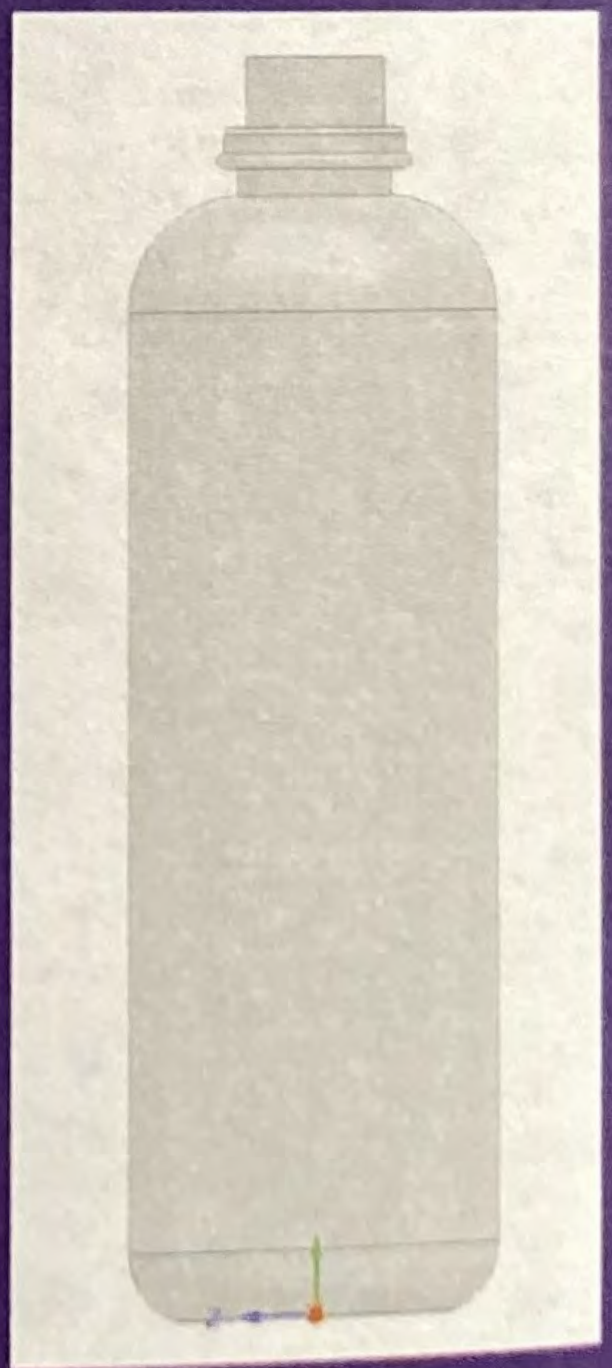
COMPONENTS OF OUR DESIGN

AIR PUMP

- REPURPOSED FISH TANK BUBBLER. WOULD BE USED TO PUMP AIR DIRECTLY INTO OUR GAS TANK.

GAS TANK

- REUSED PLASTIC WATER BOTTLE. IT WOULD SERVE AS A GAS TANK THAT WOULD STORE THE AIR THAT IS PUMPED IN BY THE AIR PUMP.

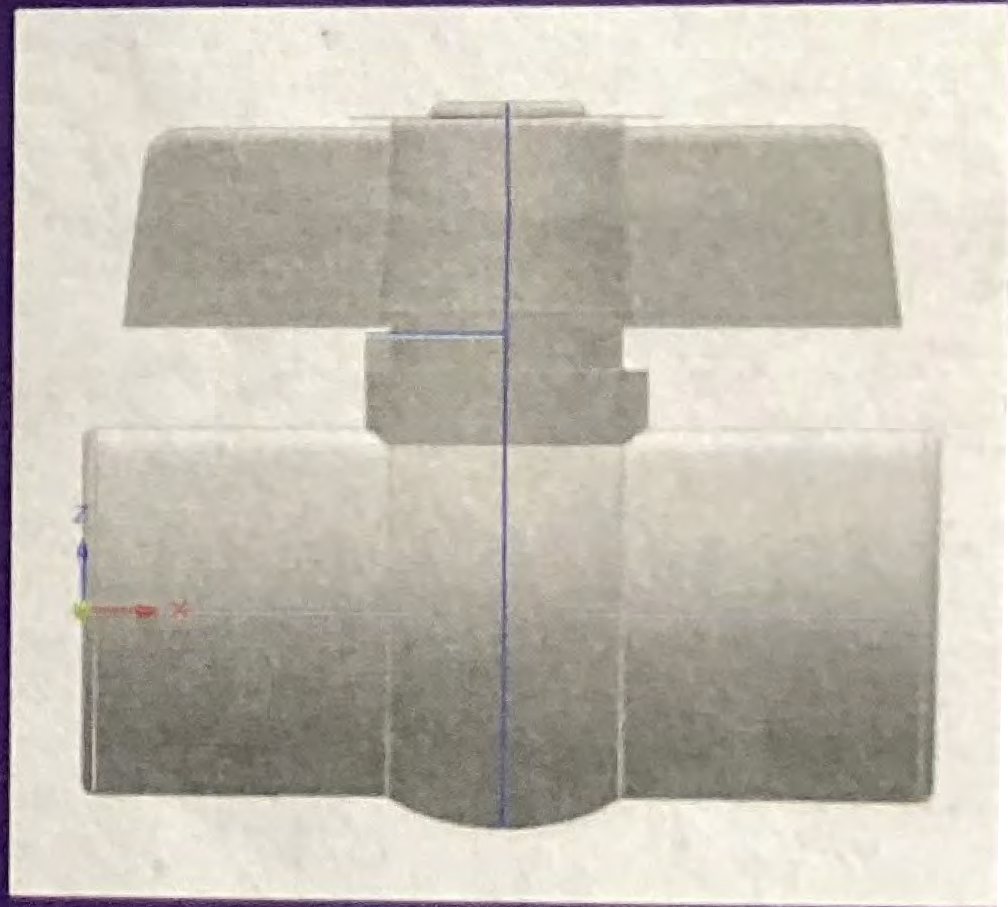


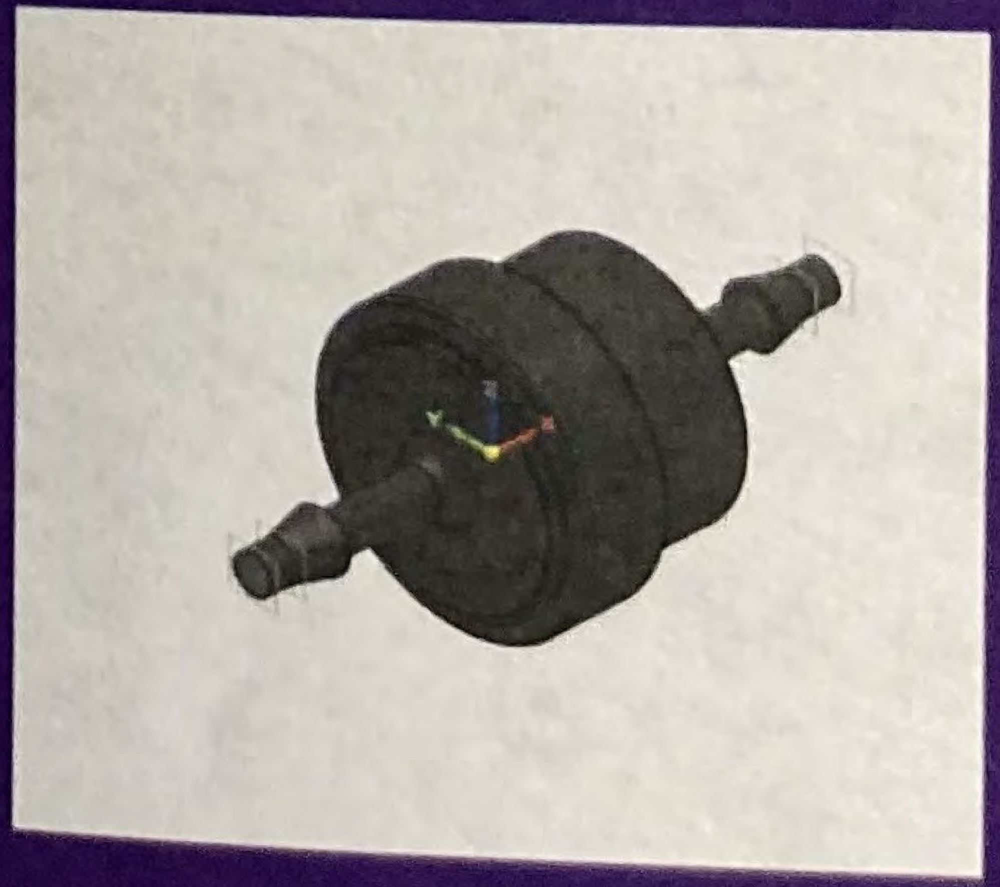
EXIT NOZZLE

- 3D PRINTED MODEL IT IS THE EXIT ROUTE THE AIR ESCAPES THROUGH WHEN VALVE IS OPEN

BALL VALVE

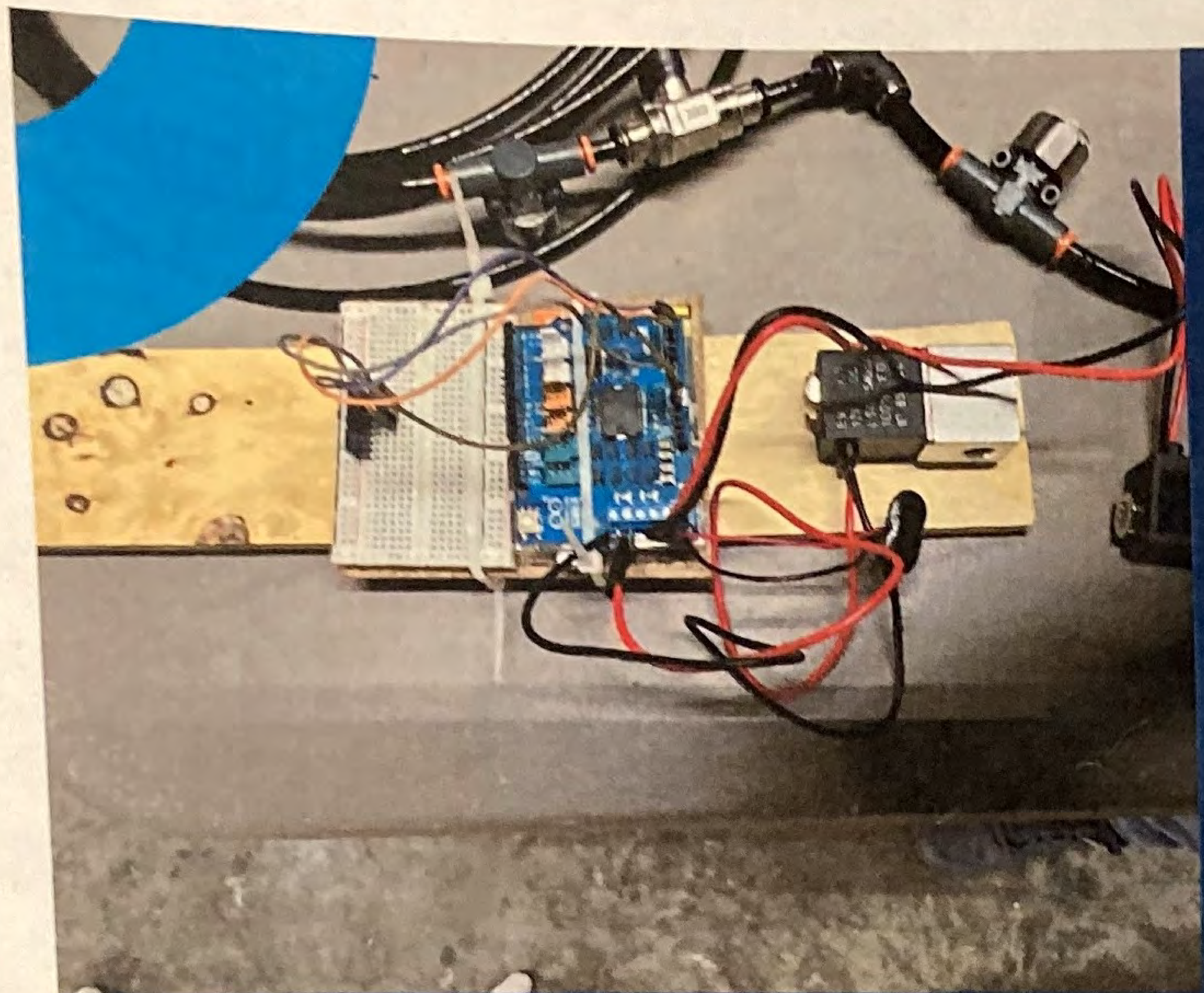
- 3RD PART 3/4" BALL VALVE IT CONTROLS WHETHER THA AIR IN THE TANK GETS LET OUT OR NOT.





ONE-WAY BALL VALVE

- 3RD PARTY ONE WAY BALL VALVE. PREVENTS AIR FROM THE AIR PUMP FROM ESCAPING.



Prototype MK-II

The motor board was used to control 2 solenoids using 1 board. A 9V Battery is used to power the solenoids. (since the solenoids will not be fired at the same time, there isn't a need for a higher Voltage battery. This system can modulate the 2 solenoids to fire when they reach certain angles away from the center (origin) point.

The Current Tank system uses 2 one liter air tanks attached to a 12 V 18A air compressor powered by a 12V Lead-Acid. These tanks are used to store air, produced by the pump, for late use by the solenoids.

About Us

Teacher

Ms. Smith

School

Academy High School

Website

Programming

Abhinav Ajish

Prototyping

Christian Hampton

Design

Zane Brown

NASA HUNCH

Squishy Squid - Vacuum Propulsion

Objective

To create a system that can push the Kwadropus cleaning robot to the wall of a space station

Constraints

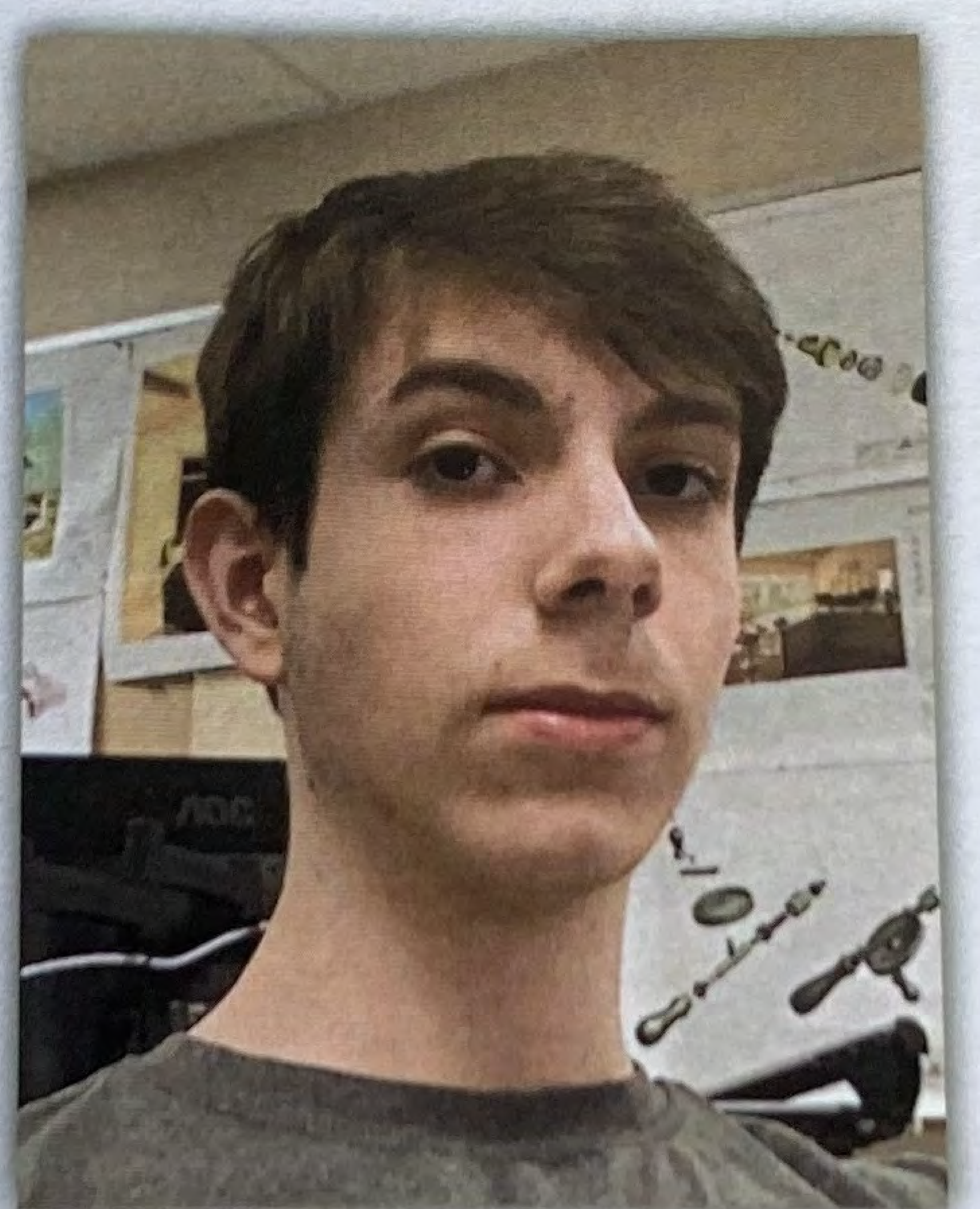
Built for 2′ diameter, 10kg robot
Must be able to be scaled down to 1′ diameter, 1kg robot
Avoids pushing dust away as much as possible
Does not rotate robot with its torque

Research

Recommended method was using chamber of air that expands and contracts
That solution requires a lot of fine control for accuracy (actuators, etc)
Problems become worse when scaled down, since all the valves need to be tiny
I tried to find a solution that uses more coarse control to be scaled down effectively

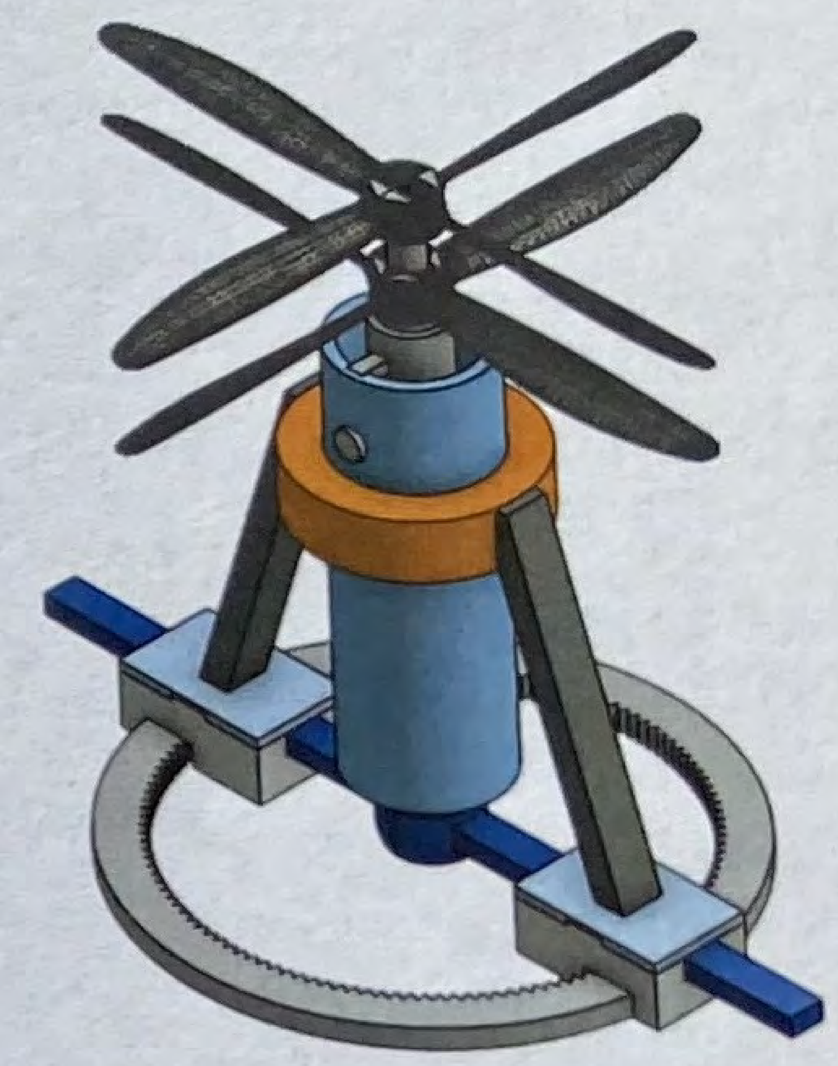
About Me

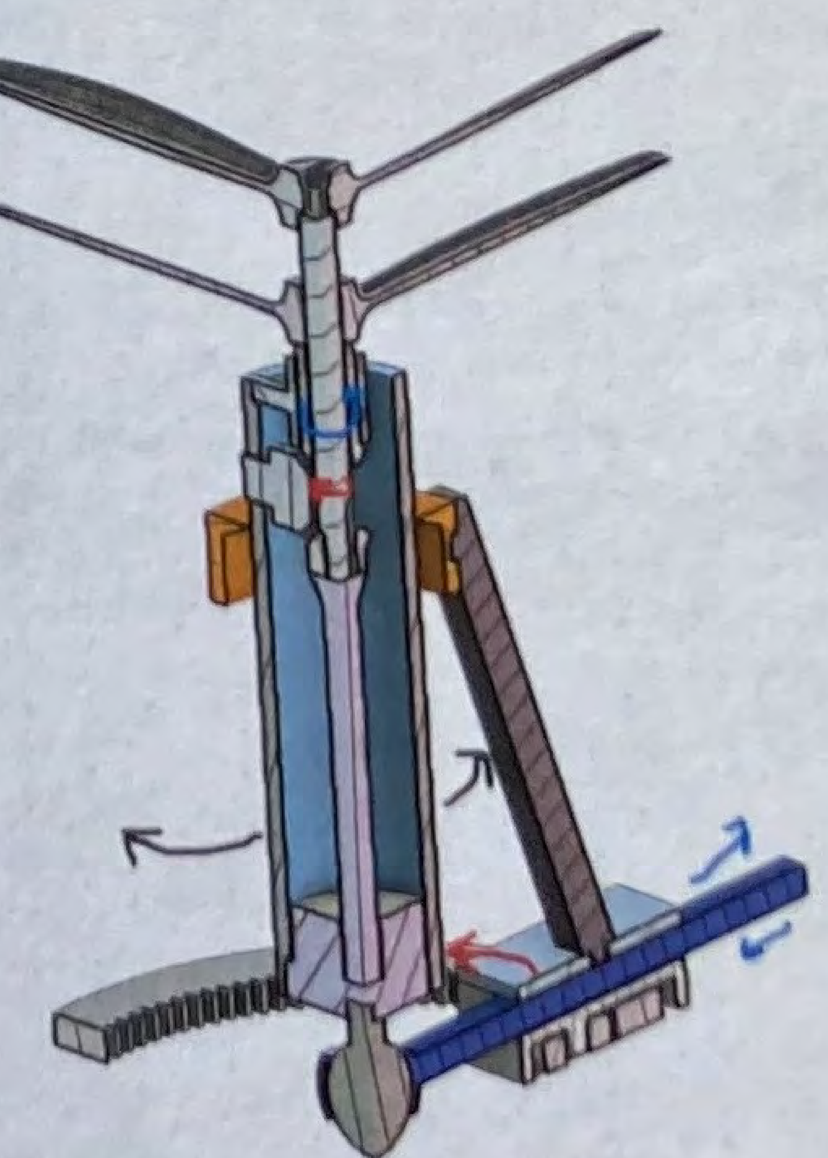
My name is Finnegan Van Hee, and I am in 9th grade. This is my first year doing NASA Engineering, and so far I have loved it! I decided to work as a one-man team this year. I am interested in becoming an engineer when I get older, along with entering the fields of astrophysics or chemistry.



Kwadropus Propulsion: Helicopter Solution

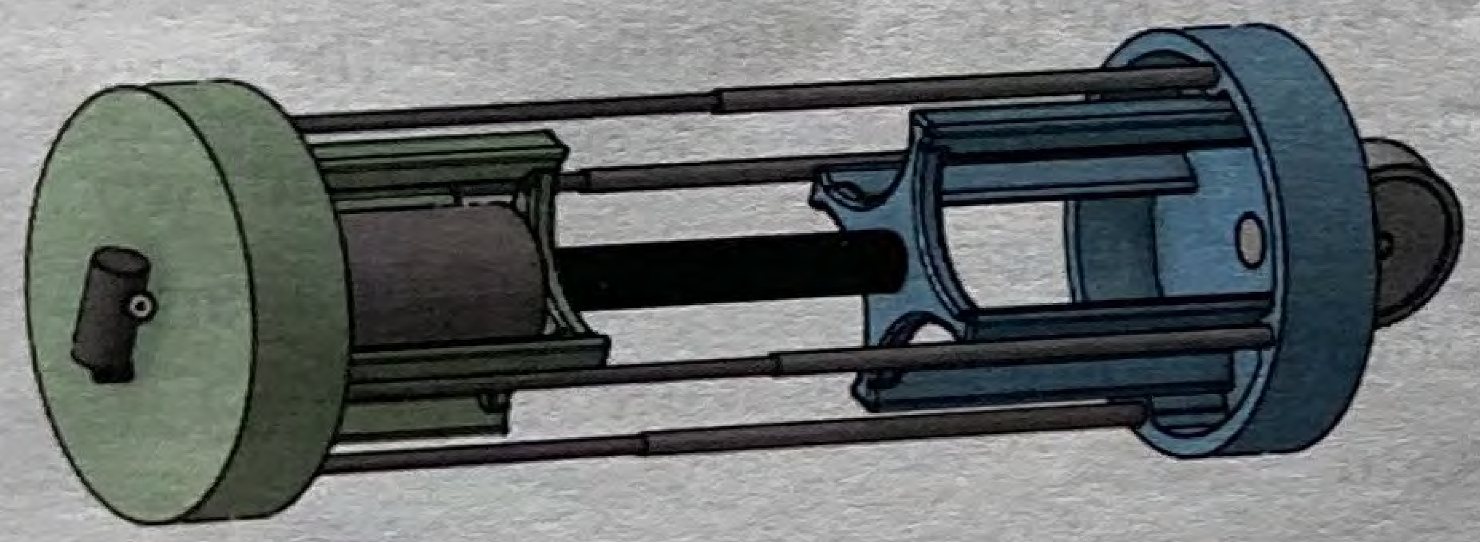
Student: Finnegan Van Hee
Minnetonka High School
Instructor: Mitchell Burfeind





Space Duster Propulsion Team

Gallatin High School - Bozeman MT
Instructor - Glenn Bradbury
Sam Stewart, Tucker Hall, Elliot Larimer, Owen Safranski

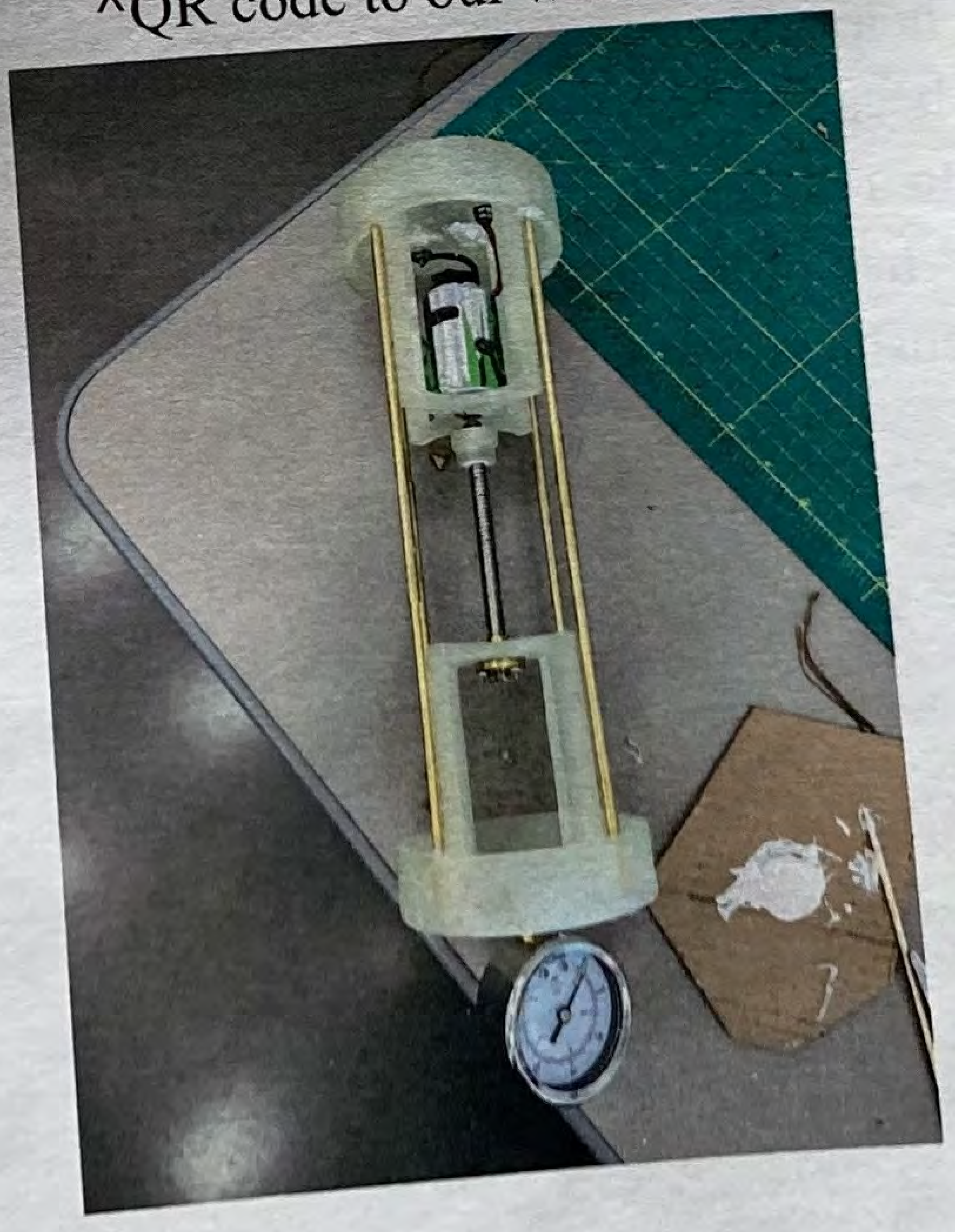


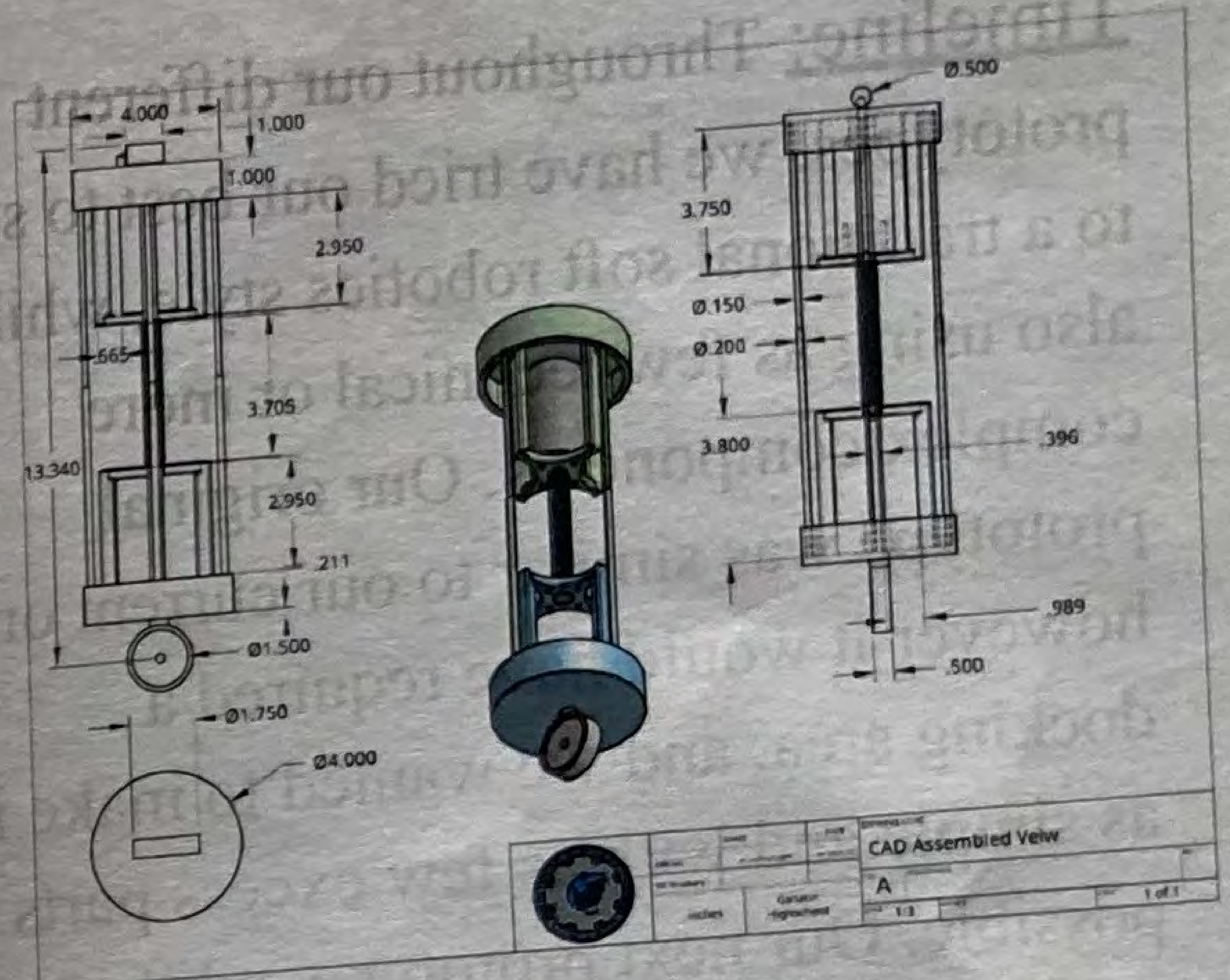
Problem: create a propulsion system for the Kwadropus Space Duster (KSD).

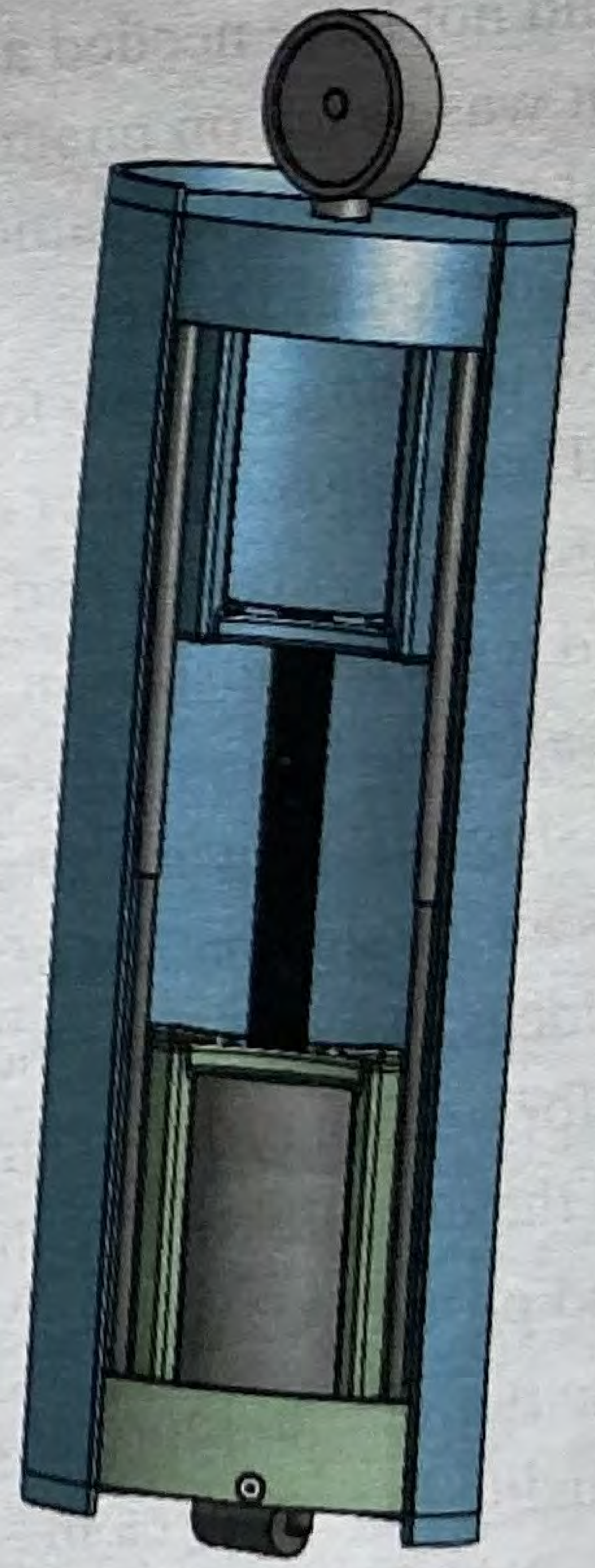
Solution: Our prototype is based on bellows and pneumatic artificial muscles. The propulsion system works by contracting the main chamber to release air out of a valve in the desired direction in order to give the KSD enough momentum to get back to the wall. The chamber then expands back to its original size using the vacuum created within to suck air back into the main chamber to be used again when needed.

ElliotRLarimer.wixsite.com/Gallatin-Duster-Thru

^QR code to our website^







Timeline: Throughout our different prototypes, we have tried our best to stick to a traditional soft robotics style, while also using as few technical or more complex components. Our original prototype was similar to our current one however it would have required a docking area, and we wanted to make it as simple and with as few excess parts as possible. Our next prototype, while in theory would not have needed a docking station, as it was based on pneumatic muscles and worked on the same general principle as our actual Duster Thruster—by utilizing a screw to bring the front and back ends together and thereby creating pressure—it had four chambers and we were unsure on how it would physically work in the real world as far as releasing the air went. Our final prototype was an amalgamation of our two previous ideas, we swapped the four chambers out for one, in order to simplify it, but we used the compression technique from our second prototype. We also switched to base our design more closely on bellows, by using the changes in pressure to both release and take in air.

External: For our outer layers, we wanted something that would be flexible, but also sturdy enough to handle the pressure without becoming malformed. We ended up landing on using a painter's tarp, as it was both flexible and sturdy enough for our purposes; it was also more affordable than our other ideas such as vinyl or some kind of leather. We also used a mesh sleeve in order to try and help protect the prototype from scratches or being popped, the mesh also served to help add a sort of mechanical advantage because due to the fact that it acts similar to a chinese finger trap, tightening down when pulled apart, and expanding when pushed together.

Internal: The Internal structure consists of two main hubs, the top and bottom. The top hub contains the motor and valve; and the bottom hub has a pressure gauge, or in final form vector thrust. Connecting the two hubs is a screw attached to the motor, and the back hub. It works by the motor moving the screw, and then as the screw is turned the two hubs are pulled closer or farther apart. Both hubs are made with 3D printed resin.

Supports: There are three main kinds of supports: we have the outer layered ones, which will be placed outside the plastic tarp; the inner layer ones, which will be inside the tarp, and the linear supports, which are also inside the tarp but are in between the two hubs. The outer supports are to keep the chamber from expanding too far out, along with the mesh; the inner supports are to help prevent the chamber from collapsing in on itself; and the linear supports are to prevent the chamber from twisting or bending.

CONTACT US

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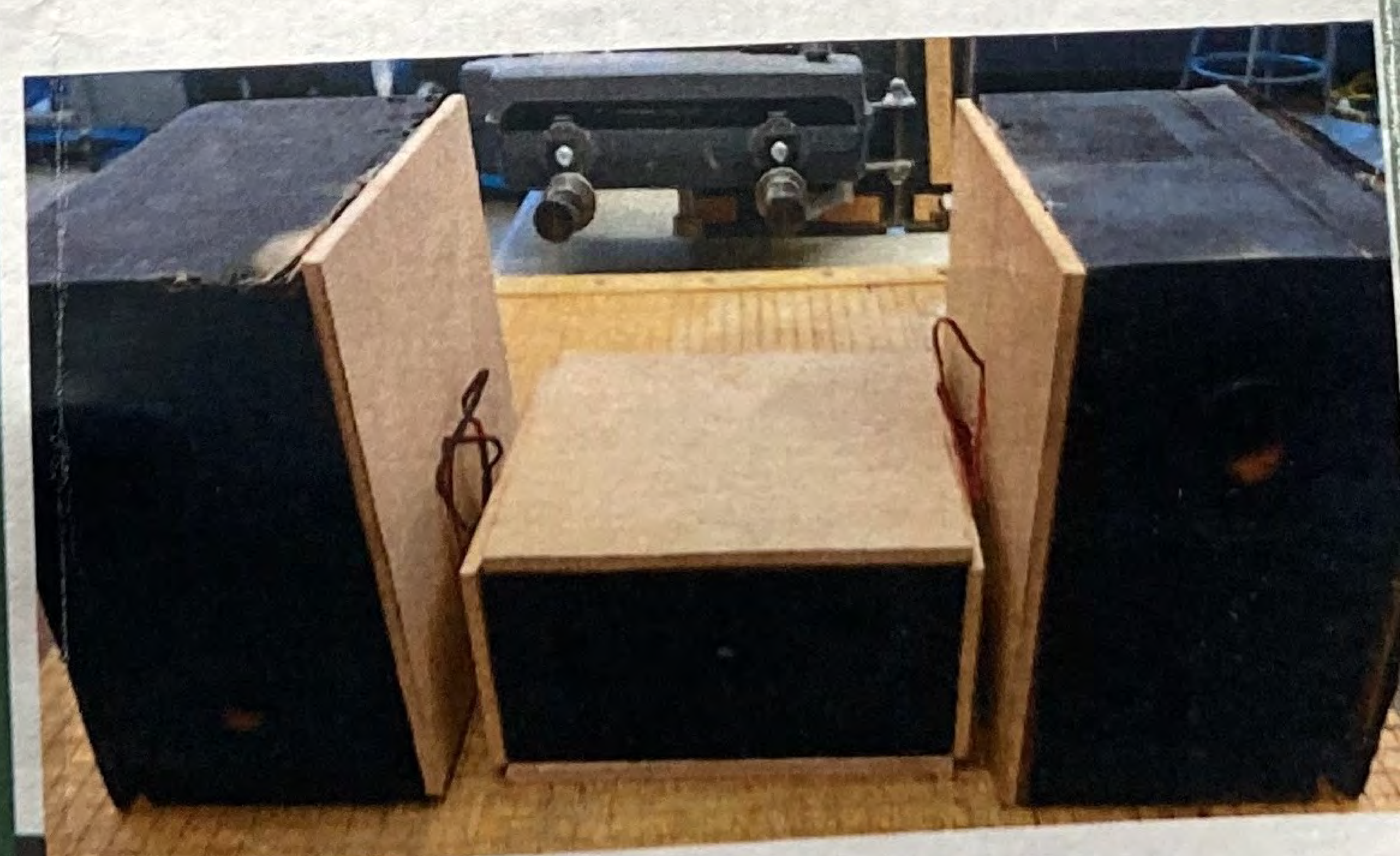
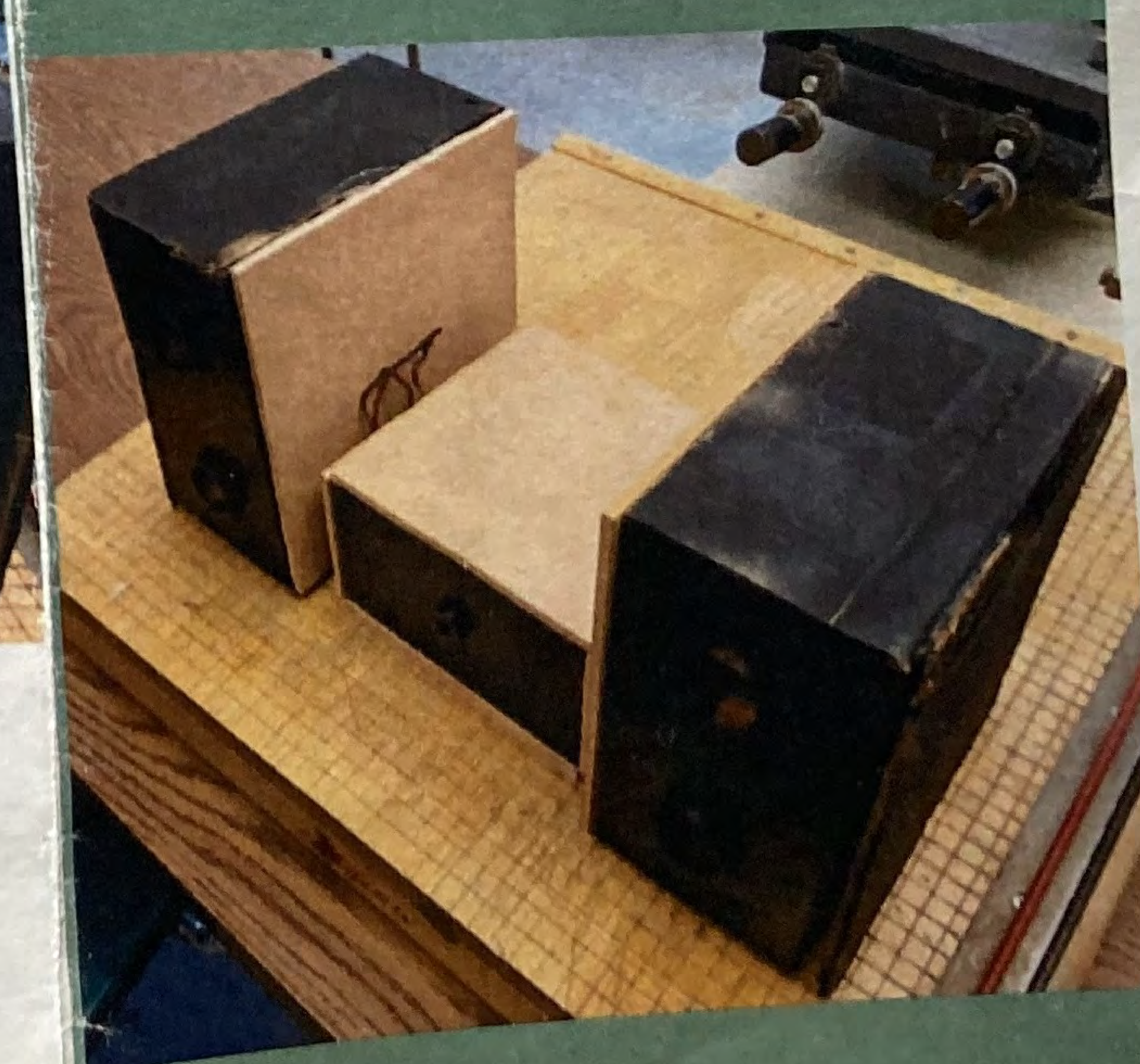
205 N 11th Ave, Bozeman, MT 59715

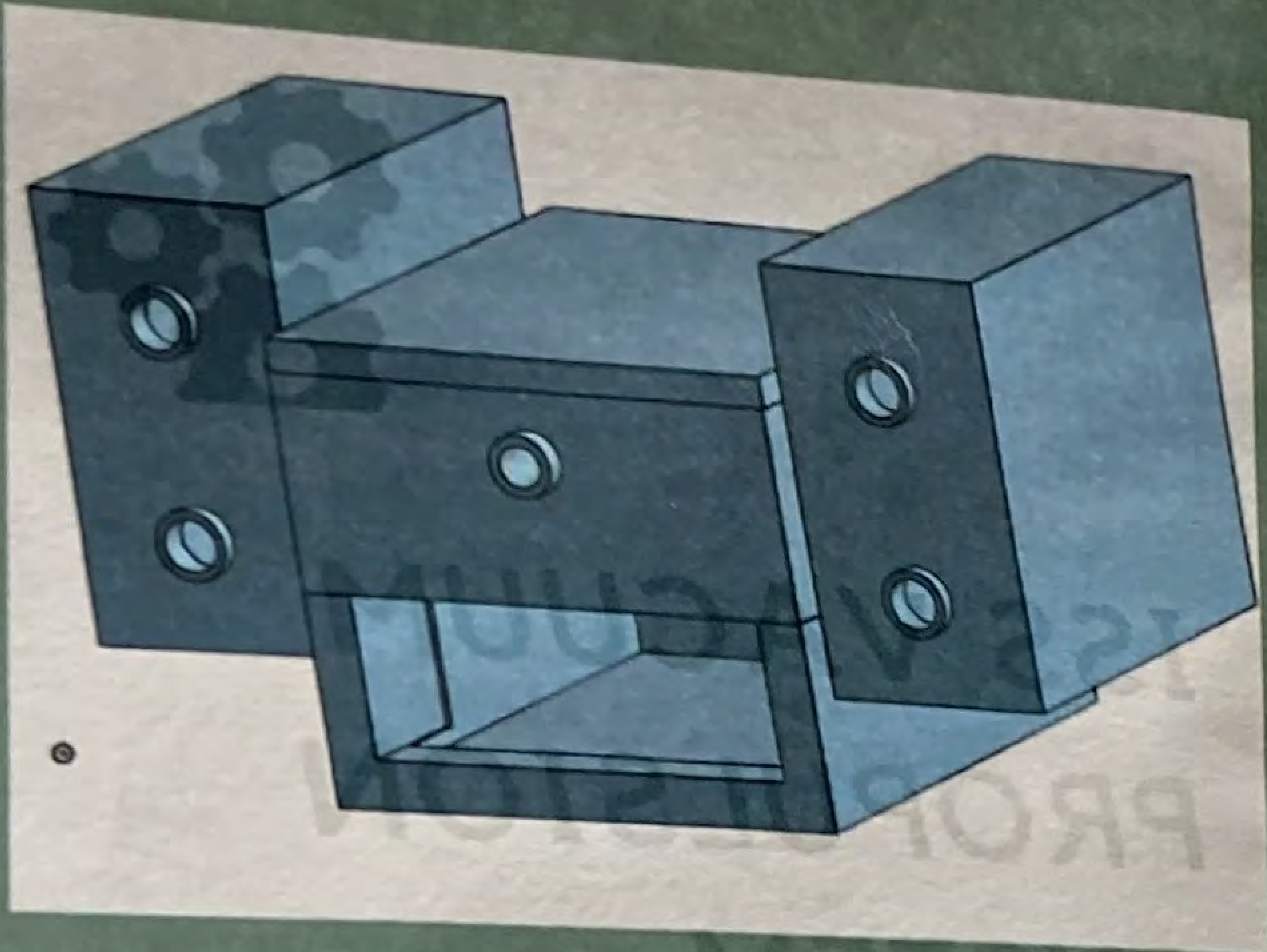
MECHANICAL SPECIFACATIONS

Our prototype uses four fans each of which can spin at 4000 RPM and generate roughly 1 newton of force. It uses a 24-volt battery as a power source. Servo motors control the orientation of each propulsion compartment to provide 360° thrust of movement. All of this will be controlled by an Arduino Uno in the center compartment. The compartment also has



ISS VACUUM PROPULSION SYSTEM





DESIGN PROCESS

While researching movement in microgravity we came across the Astrobee project. Since then, we have been focused on the idea of creating a similar system so that it can efficiently travel around the ISS while carrying the other mechanisms of this project. We looked into a multitude of propulsion mechanism but decided that fans would be the most efficient. A big obstacle for us was the torque of the turning side chambers, but we found that by rotating both sides the same amount in opposite direction we can minimize the unwanted movement.

About The Tengresity Robot

The Tensegrity bot uses fans to generate the ability to move and rotate. it uses a frontal camera to make a digital map of its environment and knows how to best navigate in its areas. It has three chambers. The center holds the “Brain” of the robot and the camera mechanism. the right side and the left side both possess rotating fan mechanisms. both of the chambers have 180-degree rotation.

Design Notebook

ABOUT US

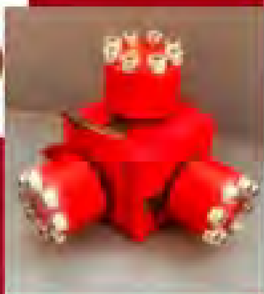
We are Sophomores at Bozeman Highschool. the two of us have experience in engineering-oriented activities such as VEX Robotics, and we have spent much of our lives researching and building mechanical marvels.

Why Choose Us?

Our robot contains a multitude of innovative concepts about movement in microgravity as well as a prototype that demonstrates how those ideas would work. In addition, our main prototype pulls from existing products such as Astrobee that have a proven track record. While our robot is not entirely programmed yet, it works as an adaptable template to propel the other teams’ mechanisms.

DESIGN

- 12cm x 12cm
- 3 internal reaction wheels
- 6 propulsion piezos



ROTATION

- 3-axis of rotation
- PID Controllers used
- Rotational angles derived from rotational velocity values

TESTING PROPULSION

- 42mm Piezo
- 4mm Orifice
- .75" Cavity

FORCE: 9.51 mN

A single SynJet can propel a 2kg apparatus 5cm/s.

Presentation & Testing

SynProp

Bethany Ray & Hubert Hsu
Sanger High School, Shaun Cauron

Our design uses two key mechanisms: **reaction wheels** and **piezoelectric discs**. A compact reaction wheel system enables **3-axis rotation**. The piezos generate **synthetic jets** which propel the device. Our design is **cheap, lightweight, and scalable**.

GENERAL INFORMTION

- We have created a 7"x7" propulsion robot using reaction wheels and toroidal propellers.
- We faced the challenge of orienting a robot within a microgravity environment that will be safe to be around the astronauts and gear in the ISS.
- The most important things our product needs to do are safely move back to the walls of the ISS, move 10 kg of force, and to operate quietly.
- To prove that our product meets the requirements, we performed a series of tests and worked with several experts. We tested our design using the string method. We also worked with experts to further understand our project, including Professor Paulo Lozano, an aerospace engineer, at MIT.

Visit our website by scanning the QR code above for further information!

https://sites.google.com/tri-county.us/hunch-propulsion-2

Contact Us

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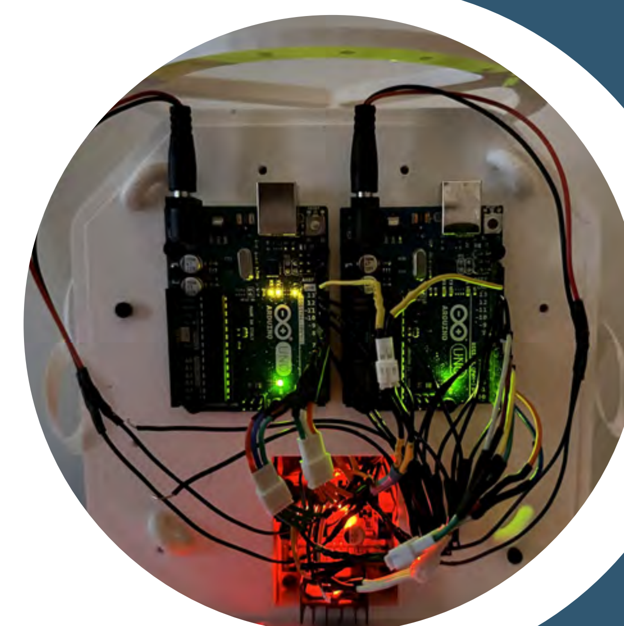
KWADROPUS PROPULSION



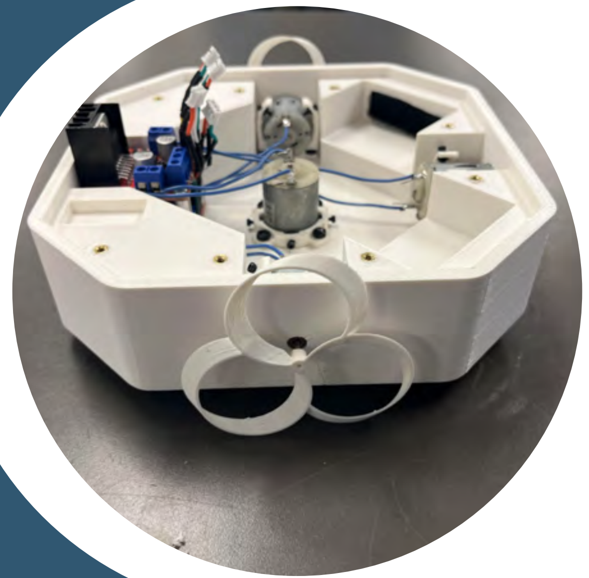
PROPULSION TEAM 2:
TRI-COUNTY RVTHS, FRANKLIN, MA
TEACHER: KRISTEN MAGAS
MEMBERS: JAIMIN FARRINGTON LEET, KALEIGH STENSTROM, BRENDAN PURVIS, JADEN SAMS-DIBB

TESTING/DATA:

- **Axis**
  - Our robot can turn on the z-axis within Earth's gravity, however in a microgravity environment, it will rotate around the Y and Z axis.
- **Testing Orientation**
  - We tested our prototype by hanging it from a string and activating the reaction wheel and toroidal propellers.
- **Testing Force**
  - We tested the amount of force our propellers can move by placing a motor connected to a propeller on a scale and turning on the motor.

FEATURES:

- **Reaction Wheels**
  - Reaction wheels are a very precise way of controlling the rotation of the robot, allowing more overall control.
  - Reaction wheels keep the robot stable using a centripetal force.
  - With reaction wheels, there is no need for compressed air and does not need to charge as often as other forms of orientation.
- **Sound Levels:**
  - Because of the way they are shaped, toroidal fans are the quietest, and most efficient type of propeller.
- **Charging**
  - Our prototype only needs to stop when charging, and since it only uses one motor for each reaction wheel and propeller, it rarely needs to stop and charge.



REQUIREMENTS/ CONSTRAINTS:

- **Sound Levels:**
  - In order to keep the sound levels of our robot down, we used toroidal propellers. These are the quietest propellers we could find.
- **Must be able to navigate back to the wall if it falls away:**
  - We created a propulsion system using reaction wheels and toroidal propellers to navigate the robot back to the ISS walls.