TEAM 971

TECHNICAL DOCUMENTATION

2020

We are reinventing **education** globally by creating **communities** that break social and technological barriers. Because we can.

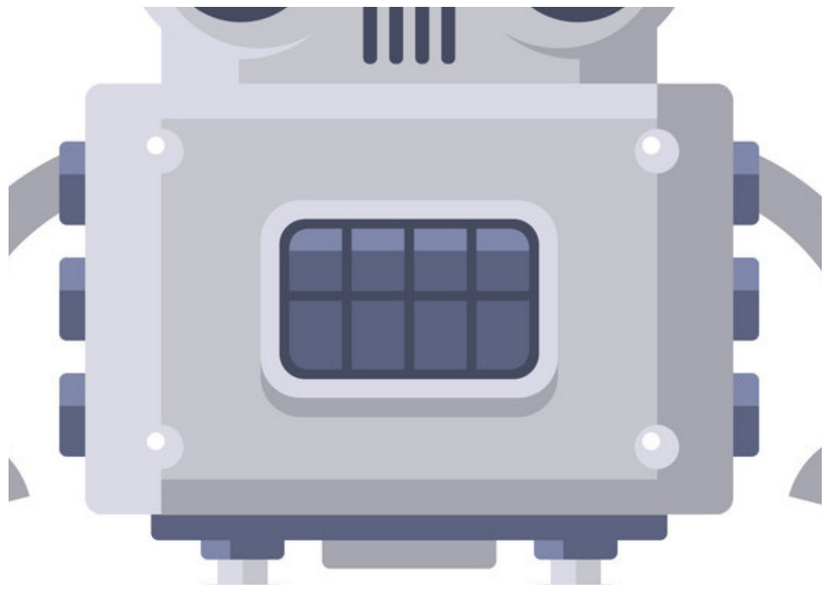
ROBOT OVERVIEW

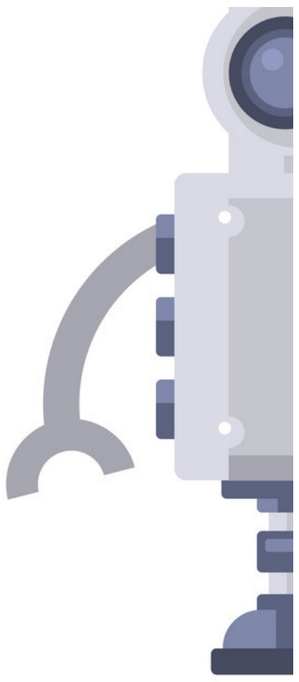
During Kickoff, we determined that our most critical robot objectives were to efficiently intake and process balls and to full court shoot.

GOALS

AKA ROBOT FUNCTION OBJECTIVES

Shoot from behind the Control Panel
Drive over 3X1 rails
Intake from the ground and HP station
Store 5 balls in the robot
Spin the Control Panel
CLimb





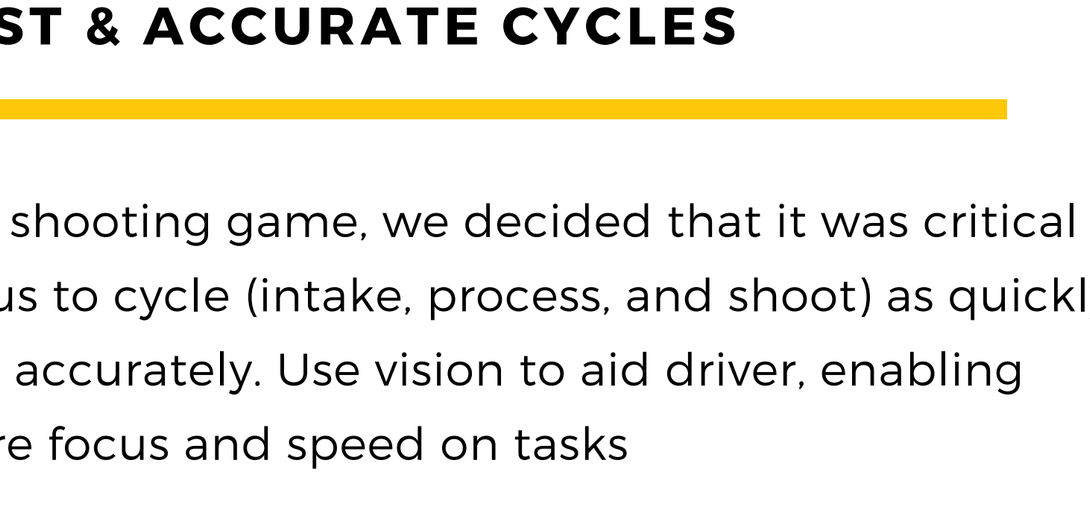
OUR STRATEGY

FAST & ACCURATE CYCLES

In a shooting game, we decided that it was critical for us to cycle (intake, process, and shoot) as quickly and accurately. Use vision to aid driver, enabling more focus and speed on tasks

THE SOFTWARE

Extract maximum preformace out the hardware by using sensors, cameras, and control loops. WE use this information in order to achieve the motion of the robot.



SHOOTER

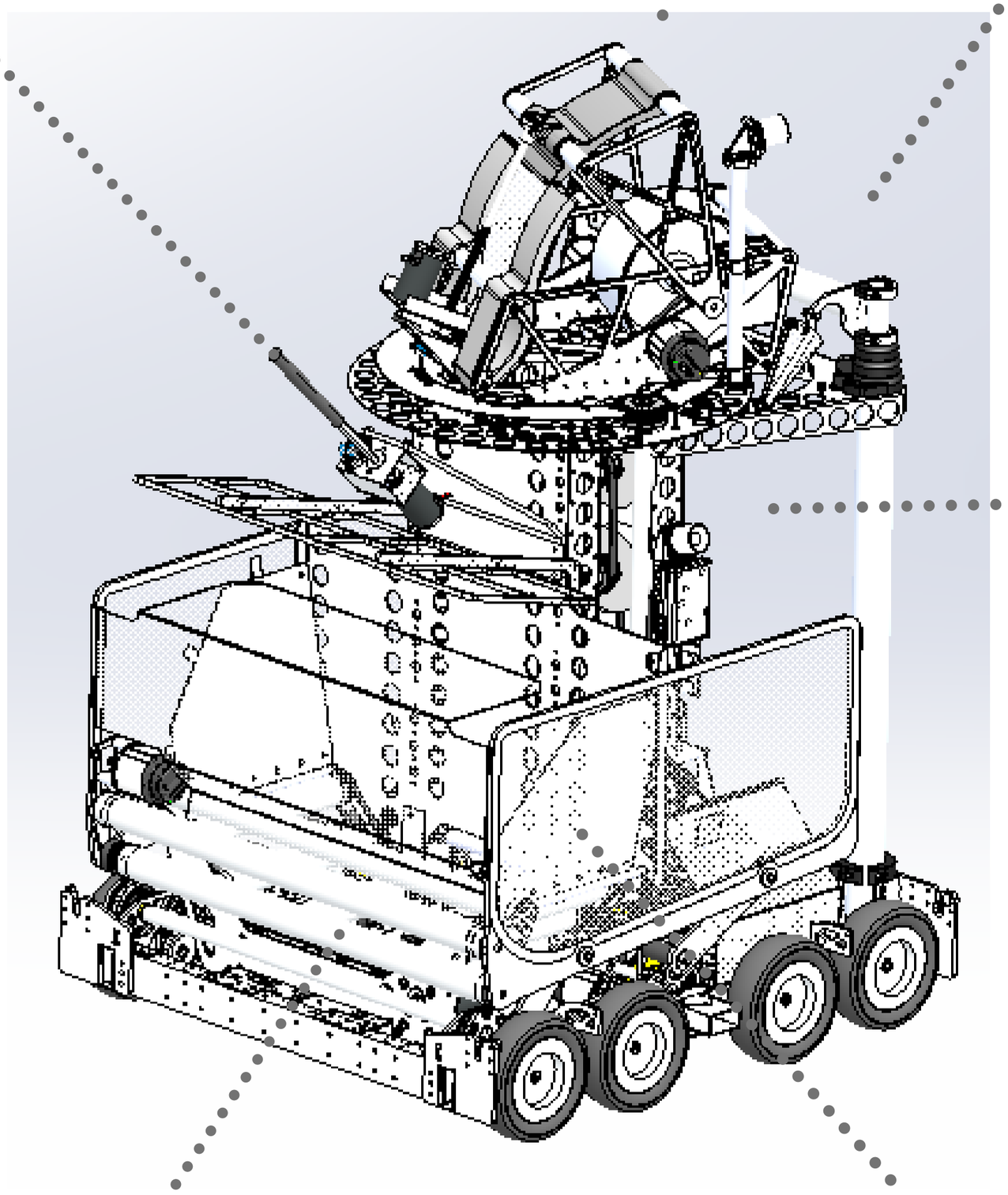
- Adjustable hood
- Turreted

CLIMBER

- 3 Telescoping tubes
- Elastically sprung, and ratcheted down

CONTROL PANEL SPINNER

- Rubber covered shaft



ACCELERATOR TOWER

- 4 sets of wheels
- Brings ball up to speed of shooter

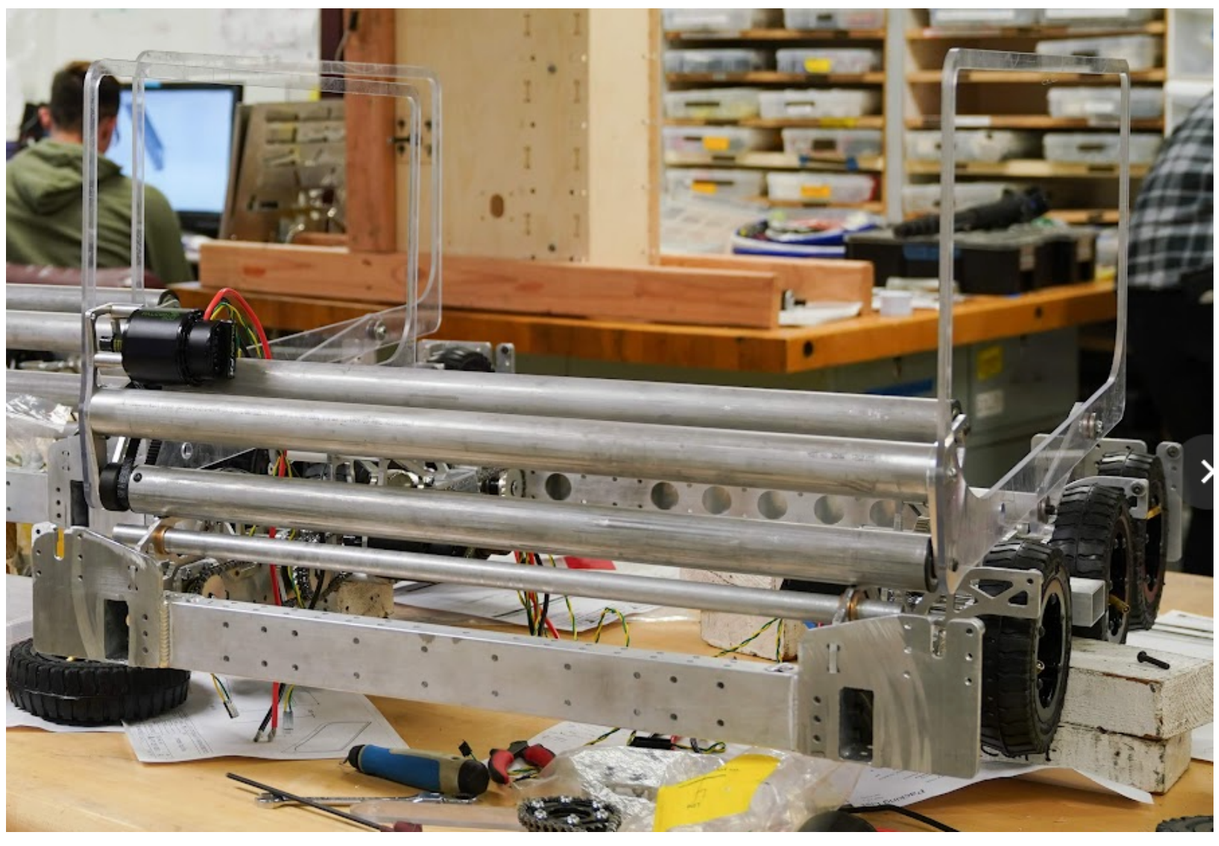
INTAKE

- Dual rollers to intake from ground
- Actuated with four bar

SERIALIZER

- Rollers all spin in same direction
- Open top to intake from feeder station

INTAKE



OVERVIEW:

- Spans the width of the robot to allow intaking multiple balls at once
- Flexible with 4 Bar made out of polycarbonate to

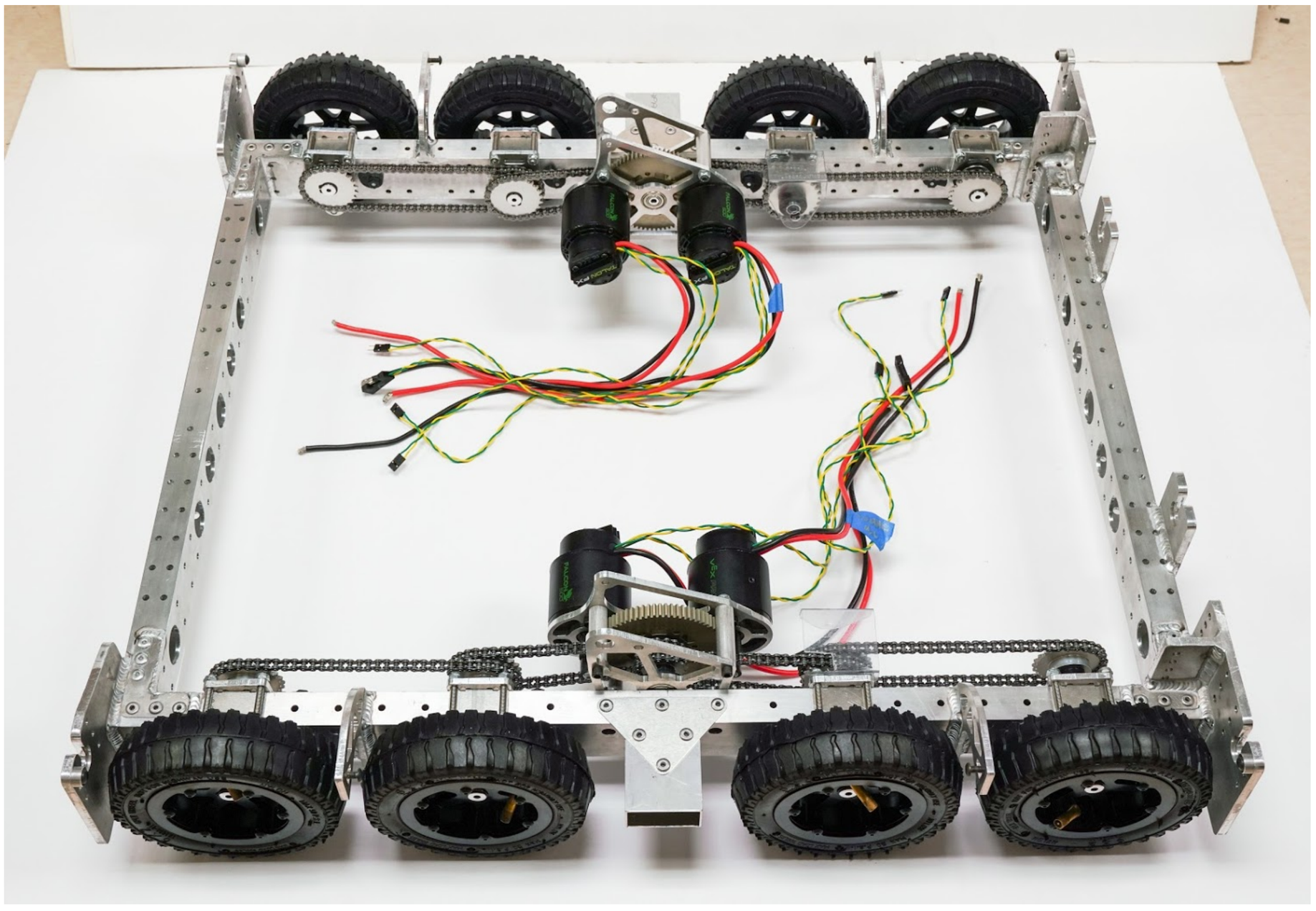
ROLLERS:

- Powered by 1 Falcon
- 1 : 1.875 ratio for both rollers
- Run at max speed : 12V

FOUR BAR:

- 1 Bag motor
- 180 2-stage versa planetary for better packaging under serializer
- 1 : 196 ratio
- Mag encoder

DRIVETRAIN



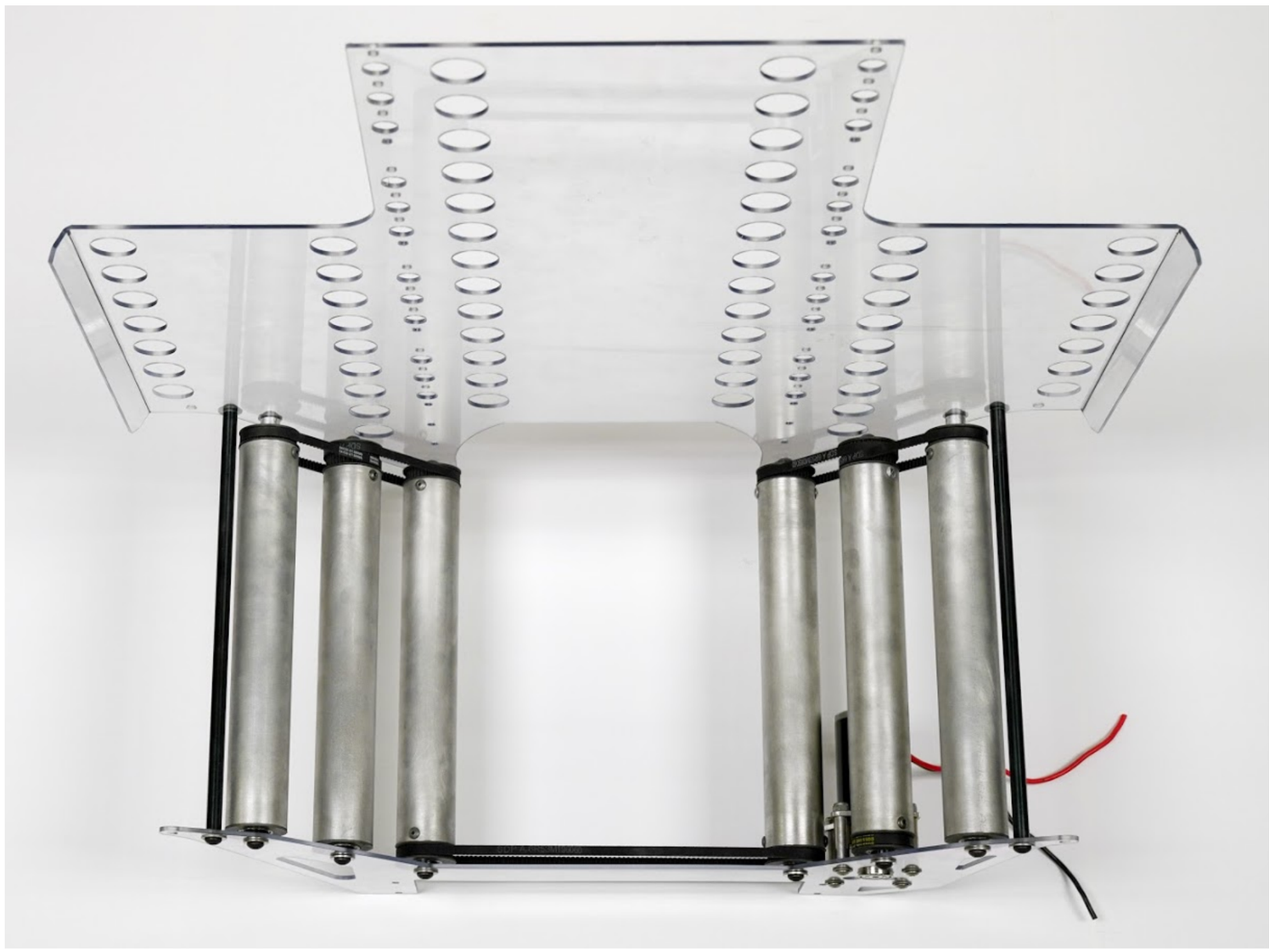
OVERVIEW:

- Made single sped with 4 falcons to have power to push robots
- Used pneumatic wheels to be able to go over 3x1 metal bars

SPECS:

- Single speed 8 wheel tank
- 6" pneumatic wheels
- 0.125" drop on 2 center wheels

SERIALIZER



OVERVIEW:

- Process balls from both Human Player station and intake by funneling into accelerator tower
- Designed for fast processing and no jaming

SPECS:

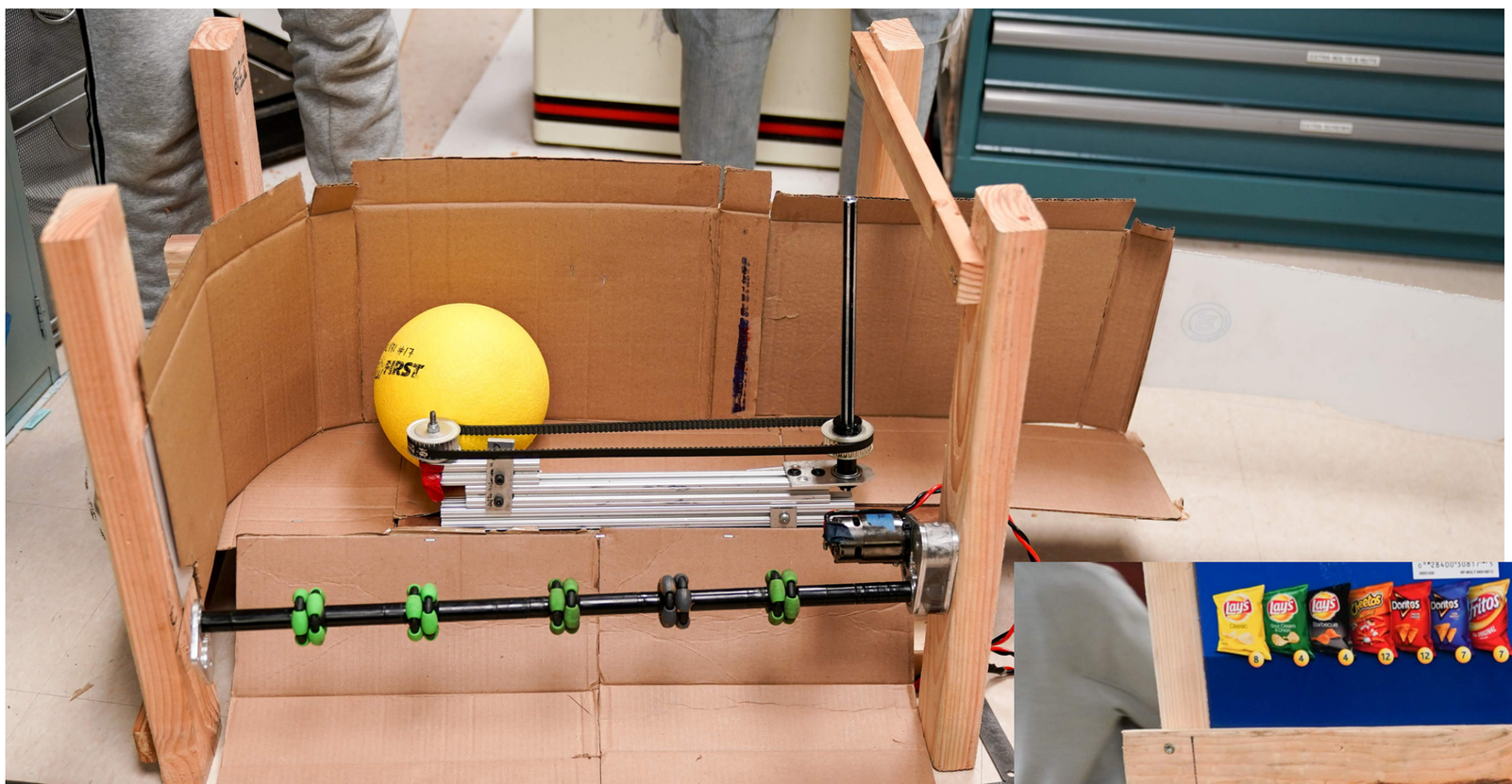
- Rollers powered by 1 Bag Motor
- Bottom Belt powered by 1 Bag Motor
- All rollers move counter clockwise

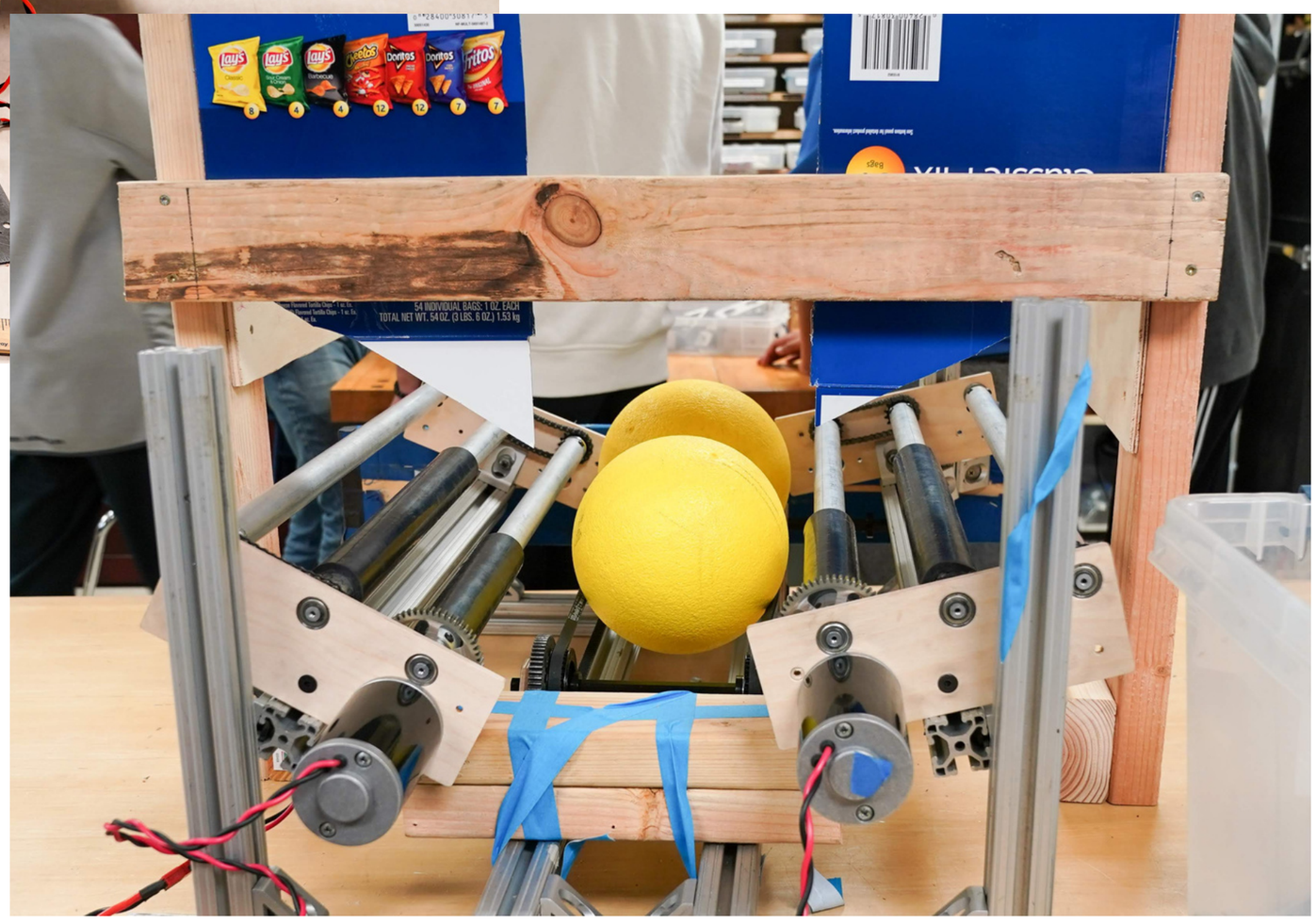
SERIALIZER PROTOTYPES

Needed to find a way to organize balls into a line and keep them from binding on each other.

Different ball paths and lining materials.

Developed the "washing machine" method, keeping the balls circulating and falling into a track.

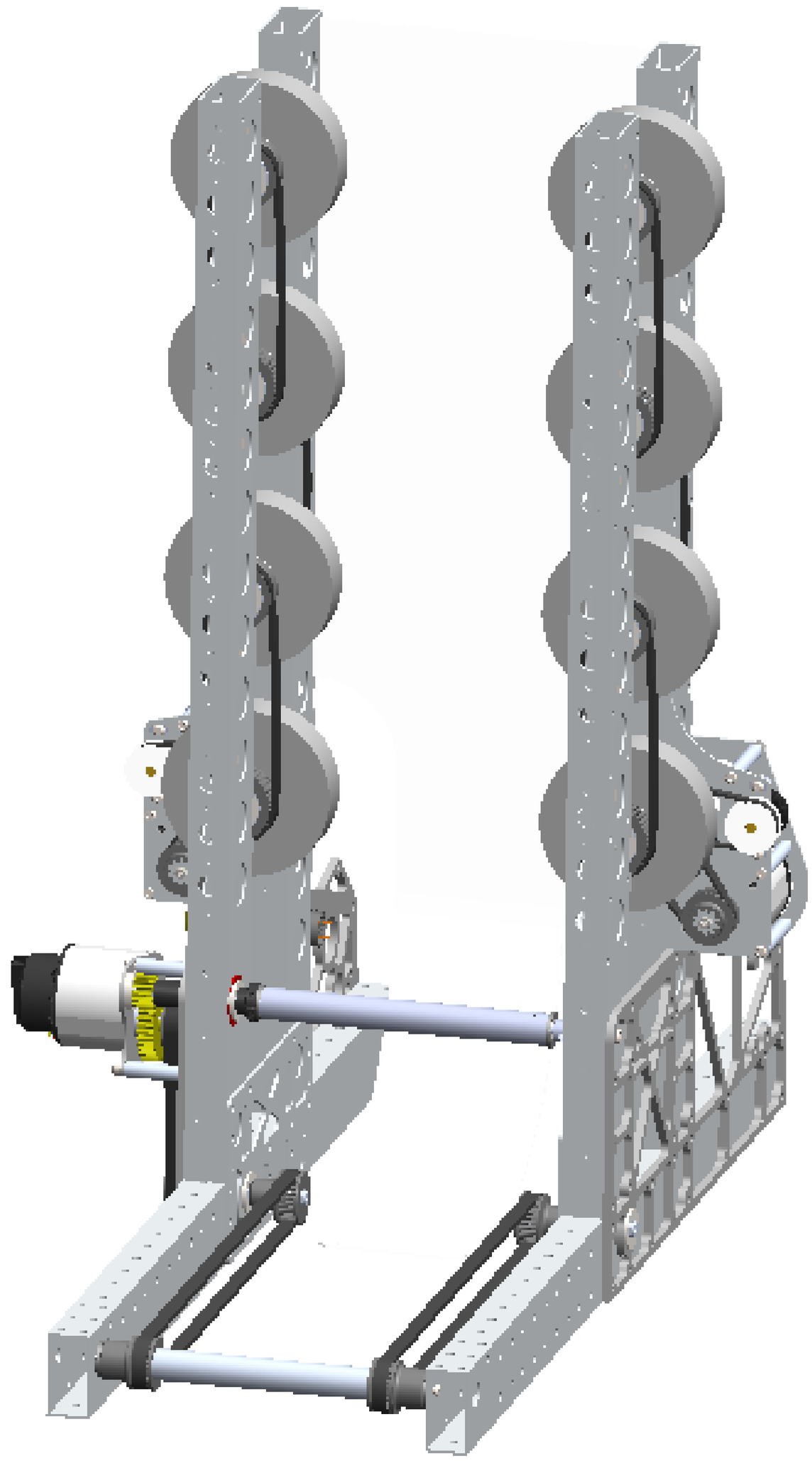




ACCELERATOR TOWER

OVERVIEW:

- Brings ball up to speed of shooter [42 ft/s] by incrementally faster wheel velocities
- X4 4in rubber wheels
- 2" compression on ball



SPECS:

- Powered by 2 Falcons
- 3D printed pulleys 0.83:1 for each consecutive wheel
- Optical encoder used for precise speed control

TURRET

OVERVIEW:

- 450 degrees of rotation
- Rolling loop to move wires
- Custom cycloid gears
- Full travel in ~0.25 secs

SPECS:

- Turret powered by 1 775 in the base of the robot
- 5.77 : 1 custom cycloid gear made in-house
- Optical encoder used

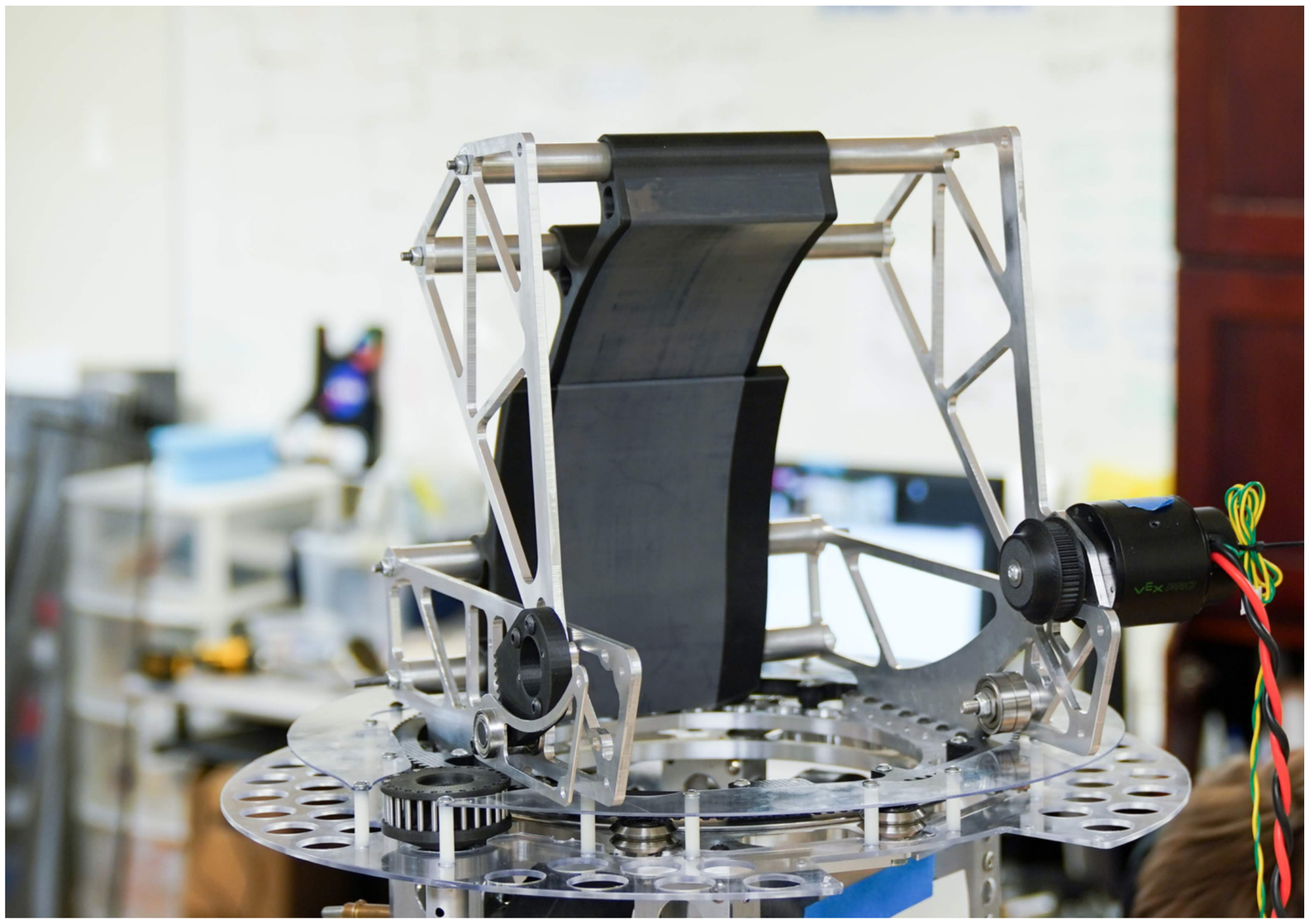
SHOOTER

FLYWHEEL:

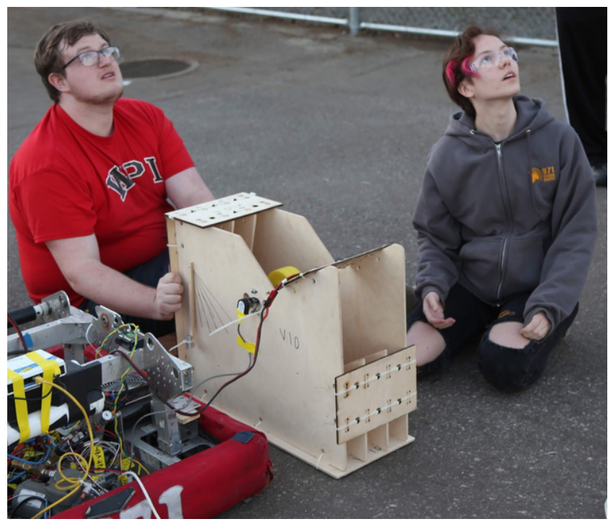
- Custom made 7 in aluminum wheel
- Powered by 2 falcons
- Shoots balls at 46.6ft/s

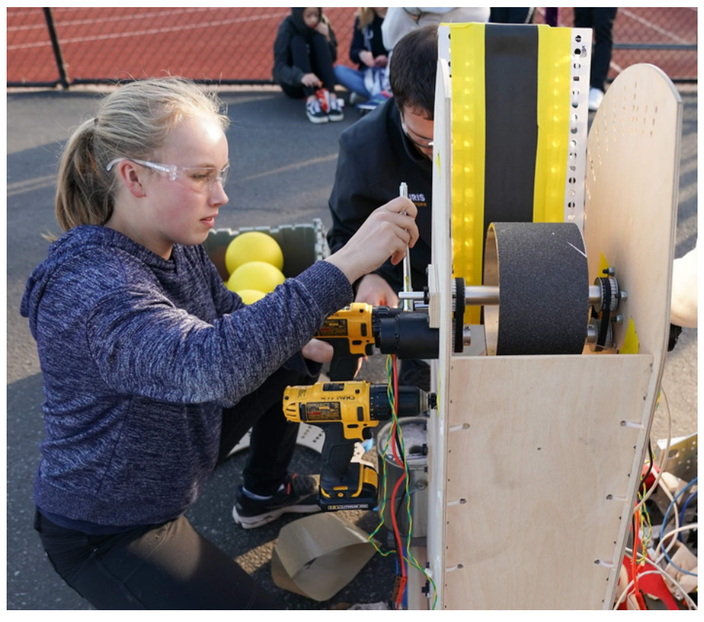
HOOD:

- 38 deg of hood movement
- 775-pro motor threaded rod actuated



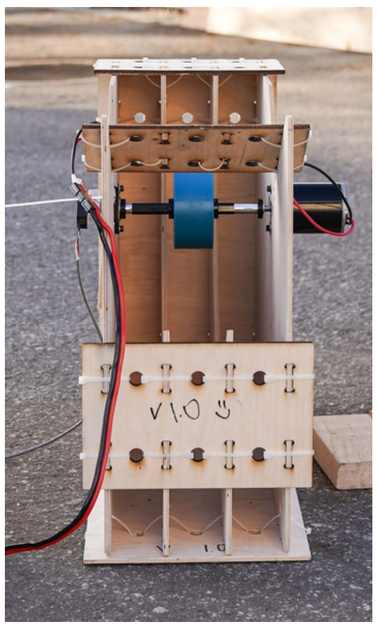
SHOOTER ITERATIONS

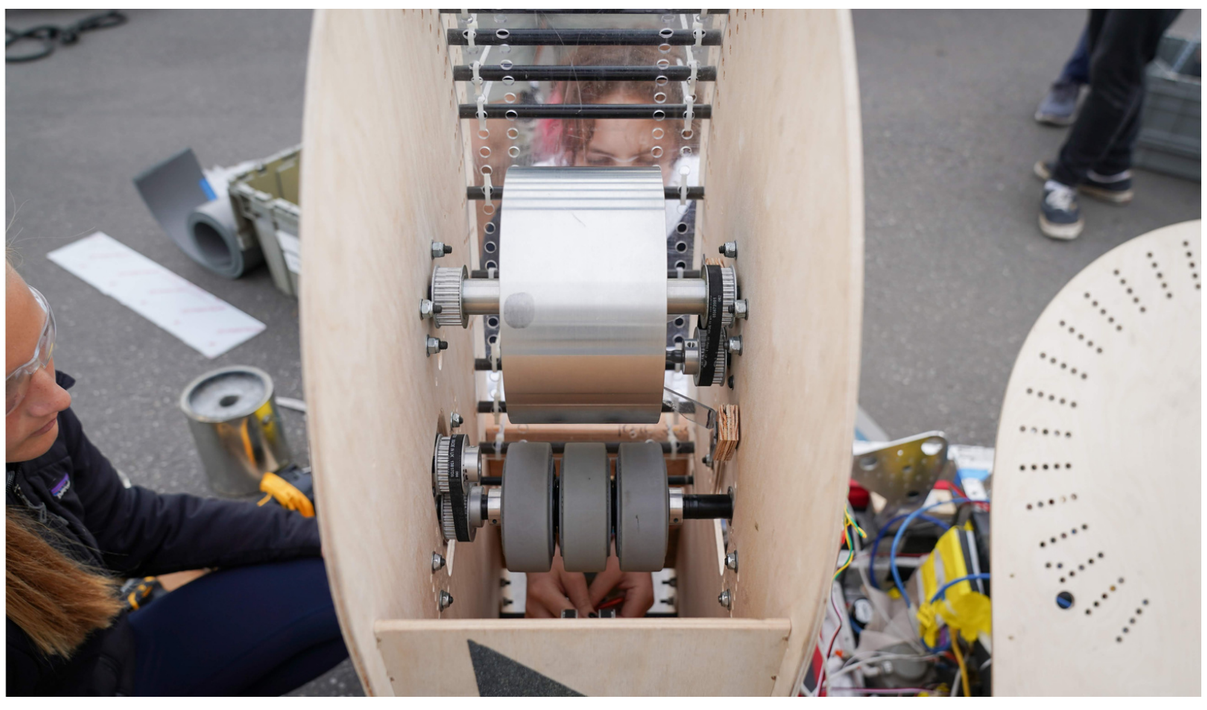




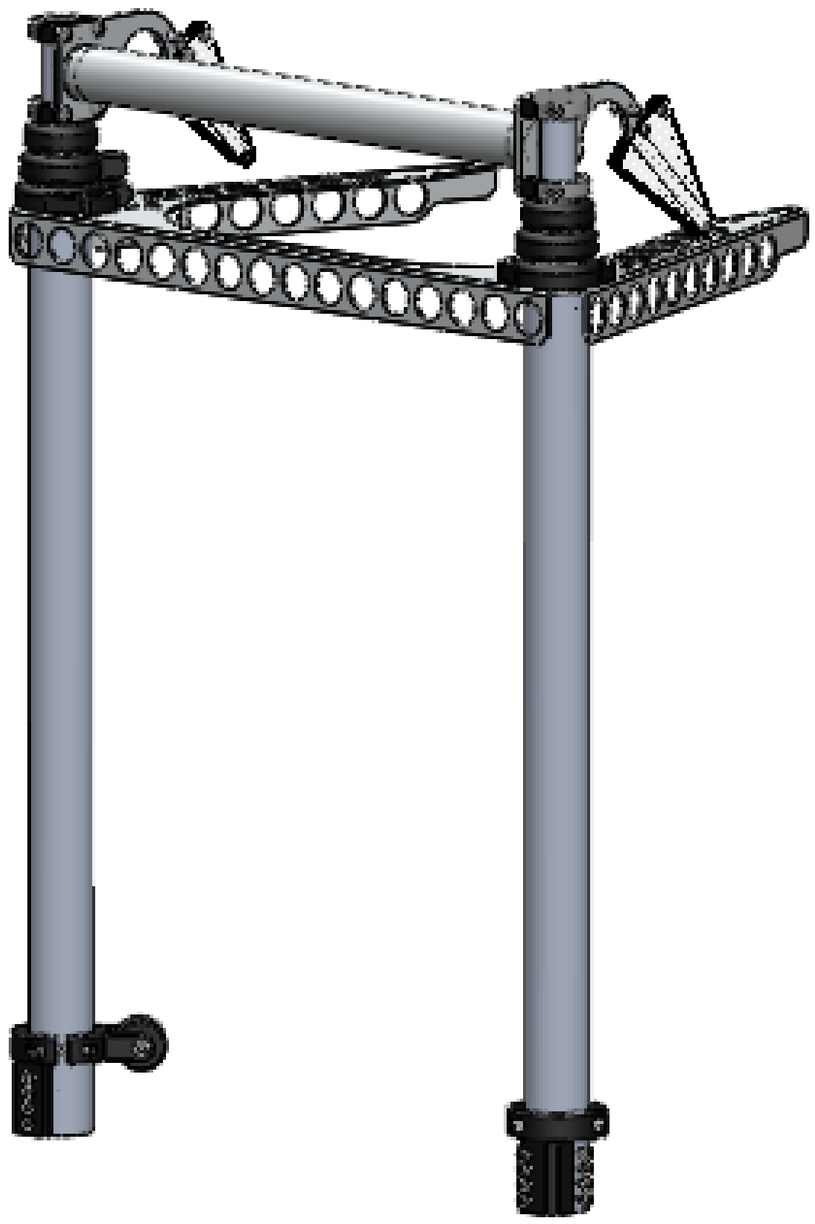
Shooter Evolution:

- Original Design: Once the ball has been fed up into the turret, it will pass through up to the hood where it will be fed into two wheels and be shot
- After long amounts of testing, we changed the design to have the ball be fed up and shot from a shooter consisting of an upper hood with adjustability to change the angle of the shot and a lower 7 inch flywheel, powered by 2 falcons that ends up shooting the ball at high speeds with a high degree of accuracy



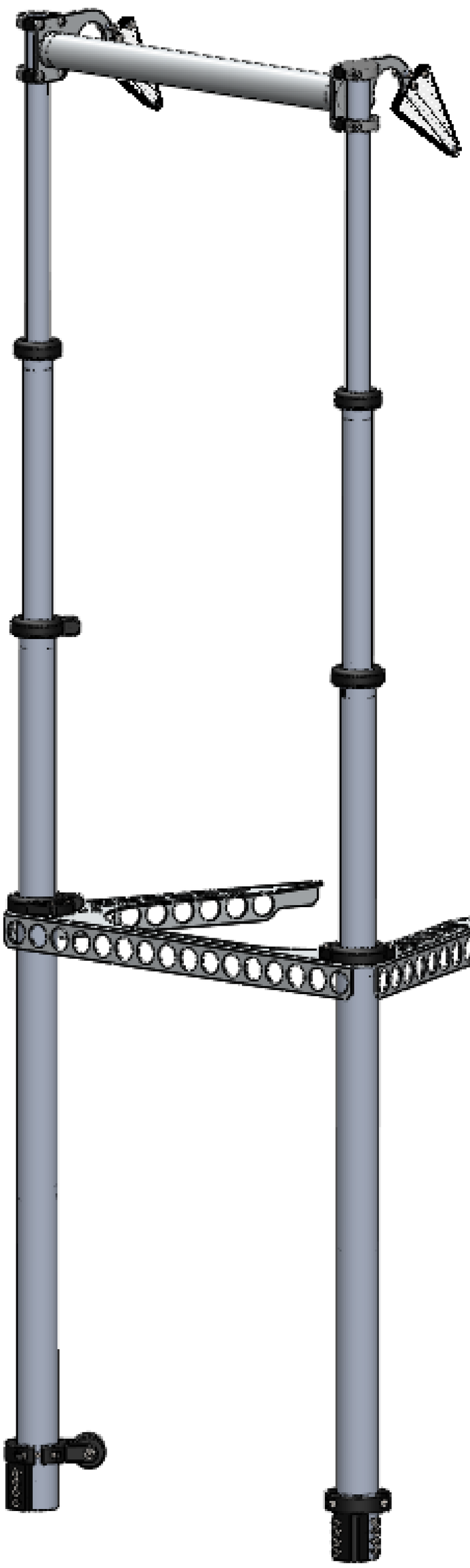


CLIMBER



OVERVIEW:

- Three telescoping tubes with 3d printed end-caps
- Elastic hooks
- Climbs in 1 second
- 12 pounds



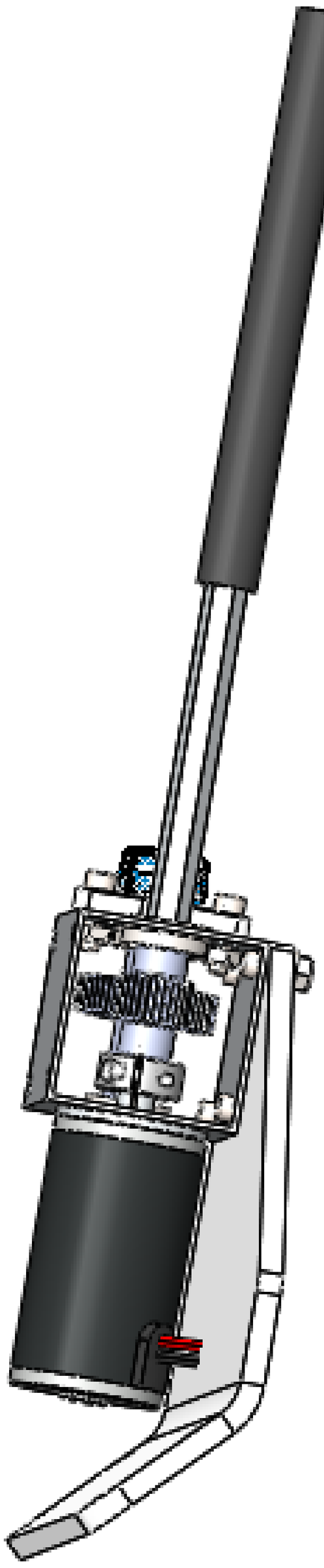
SPECS:

- Powered by 1 Falcon
- Winched 25:1 gearbox reduction
- Integrated Falcon sensor

CONTROL PANEL SPINNER

OVERVIEW:

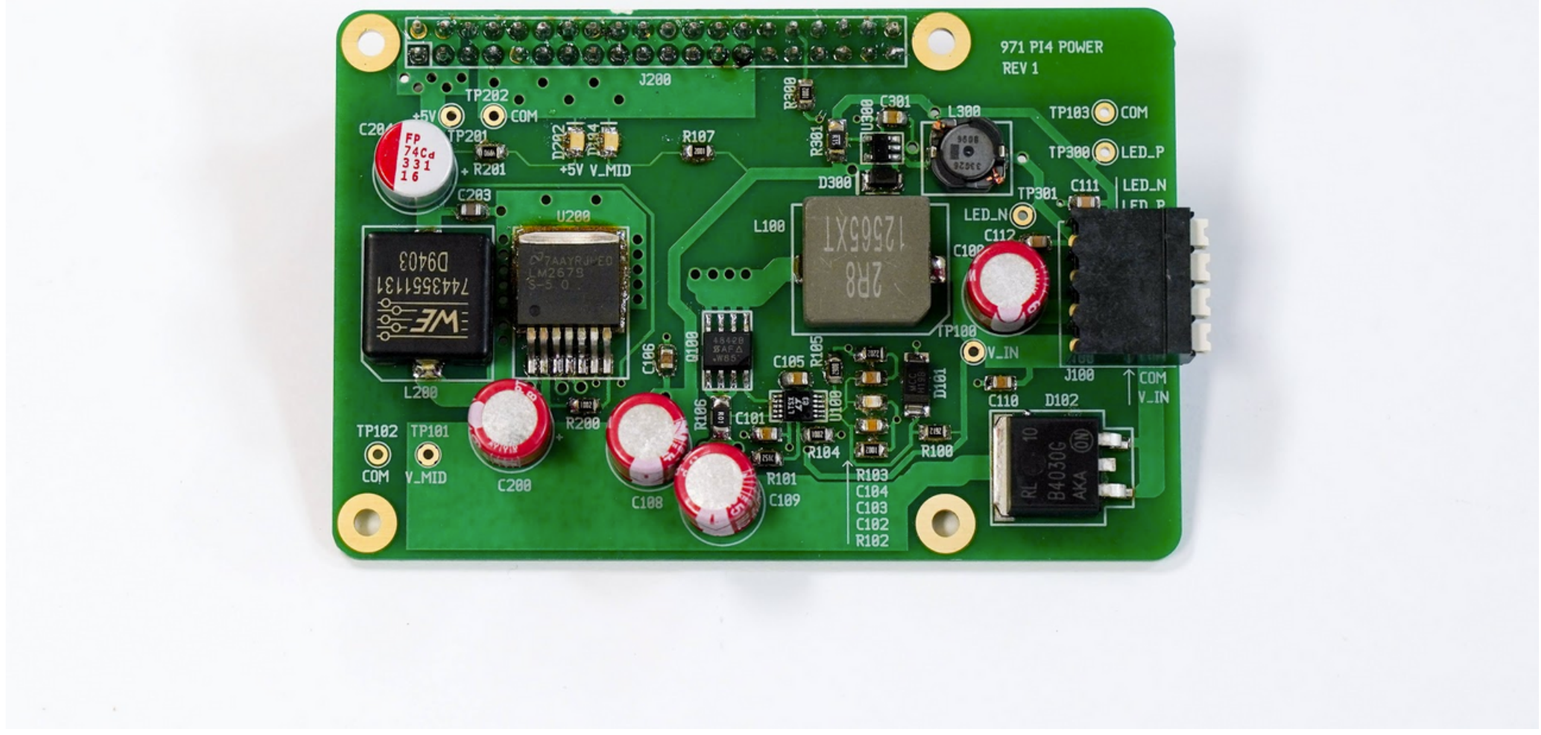
- Shaft with rubber tubing
- 3D printed shaft for encoder
- Mounted with lexan for compliance



SPECS:

- Powered by 1 Bag motor
- 1:1 ratio
- Mag encoder

VISION



OVERVIEW

- 4 cameras + driver camera to provide 360˚ field-of-view to enable shooting on the fly
- Uses field graphics to estimate robot location to score faster in auto and telop

SPECS:

- 90 degree field-of-view RGB cameras
- Each camera is attached to a Raspberry Pi with a custom power board
- Use an extended Kalman filter to do robot localization using cameras, encoders and IMU readings

CODE

INFRASTRUCTURE:

diagram of shows how in the code you can replay data logs or live systems to test the a new altrhogim to learn how the code would have preformed in those matches

- Flatbuffer based publish subscriber architecture.
- Allows decoupled communication between subsystems and implementation of rigorous testing and simulations
- Recorder events from matches and practice to reproduce and fix bugs

CONTROLS:

Kalman filters and optimal controllers:

- Able to achieve faster and mores precise control

Spline UI:

- Custom UI drawing and optimizing robot paths in auto

Localization

- Enables target tracking and precise robot control