

Automated ProStop

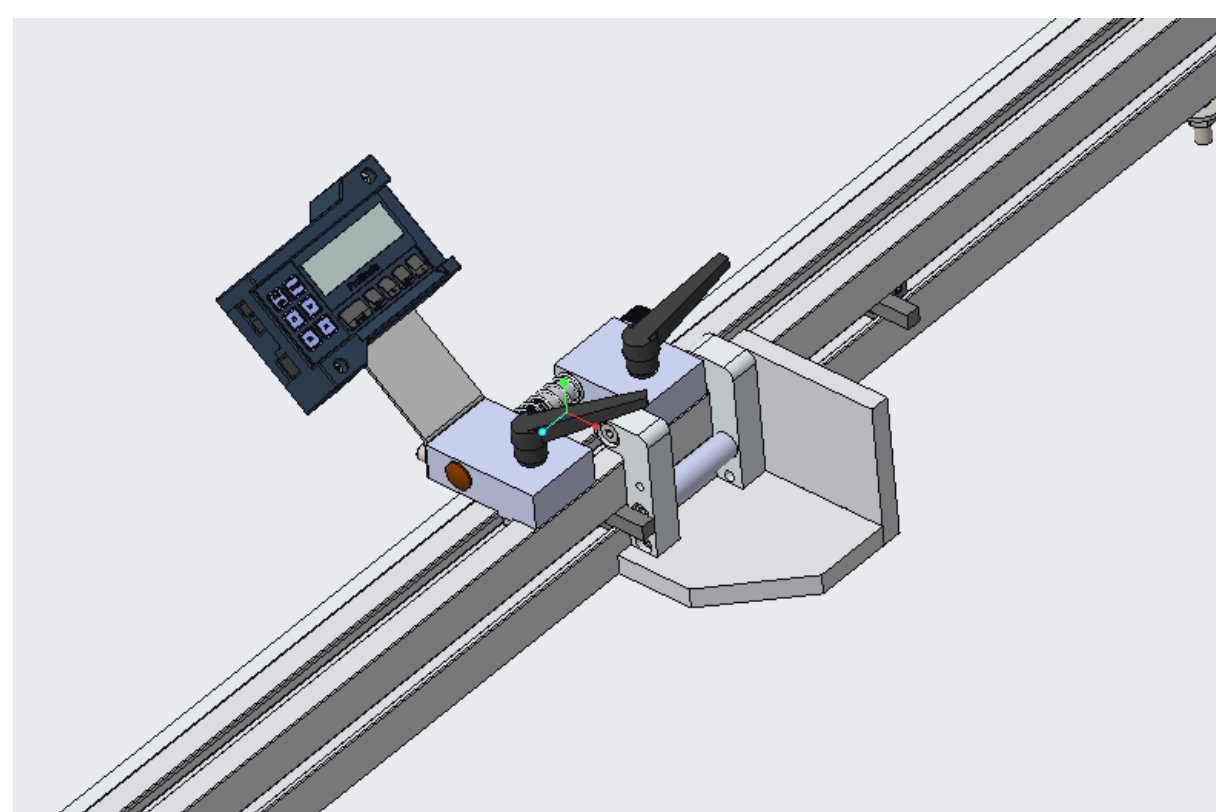
Accurate Technology Inc.

Funding Provided by:



PROBLEM STATEMENT

The team was tasked to design an automated version of a ProStop®. The current version is operated manually to move the stop along an inductive encoder. The team must explore the feasibility of various linear actuation methods



REQUIREMENTS

#	Description
1	10 ft stroke length
2	Bidirectional motion
3	Accuracy within 0.001 in
4	Ability to hold position through braking device
5	Must implement a user interface
6	Must use a feedback loop system

CONCEPTS

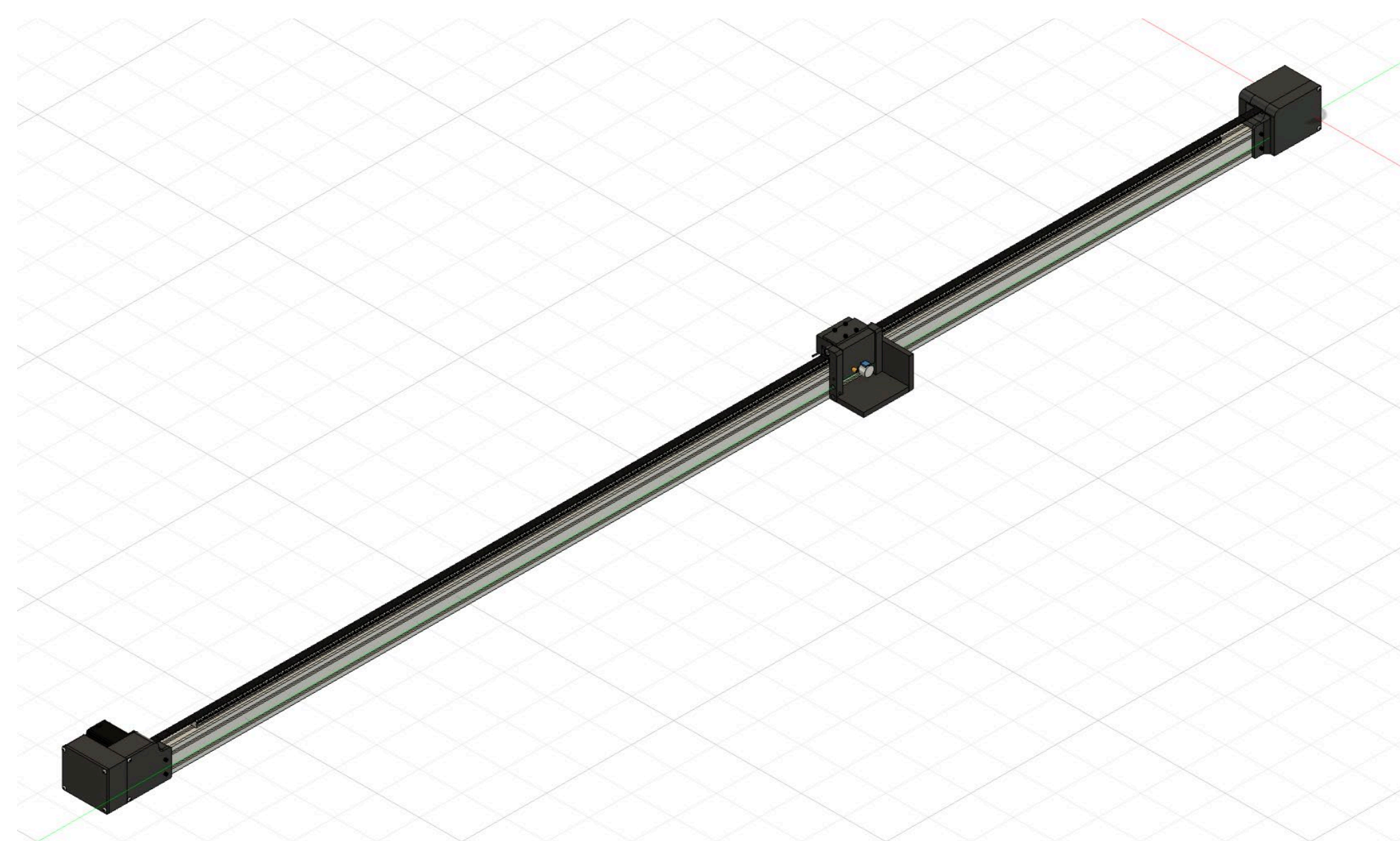


A small ball screw actuator that was used as a testing prototype in the first stages of the project.

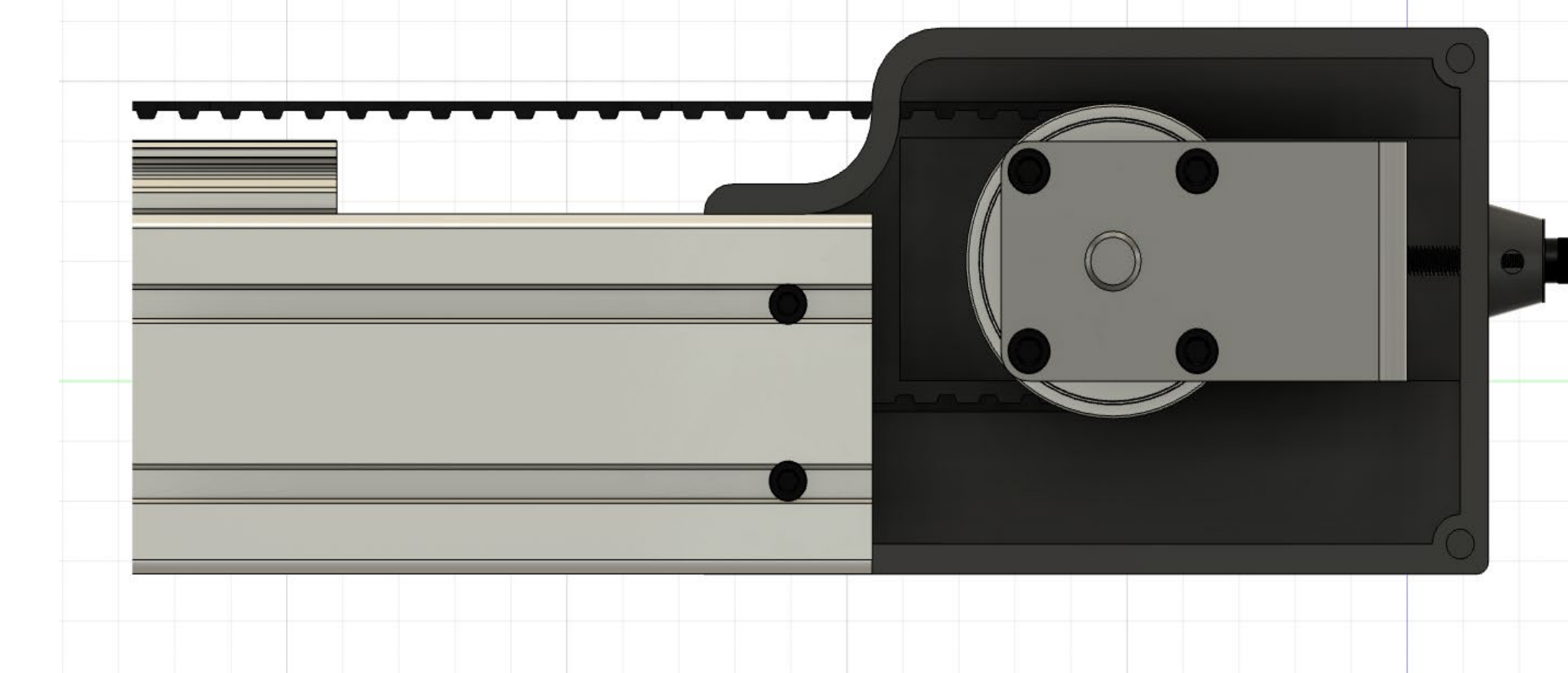
Selection Criteria	Concepts		
	Rack and Pinion	Lead Screw	Belt
Speed	4	1	4
Cost	3	2	4
Accuracy	3	5	4
Ease of Maintenance	3	3	2
Noise	2	3	4
Durability	4	3	2
Total Score:	19	17	20

Concepts Matrix

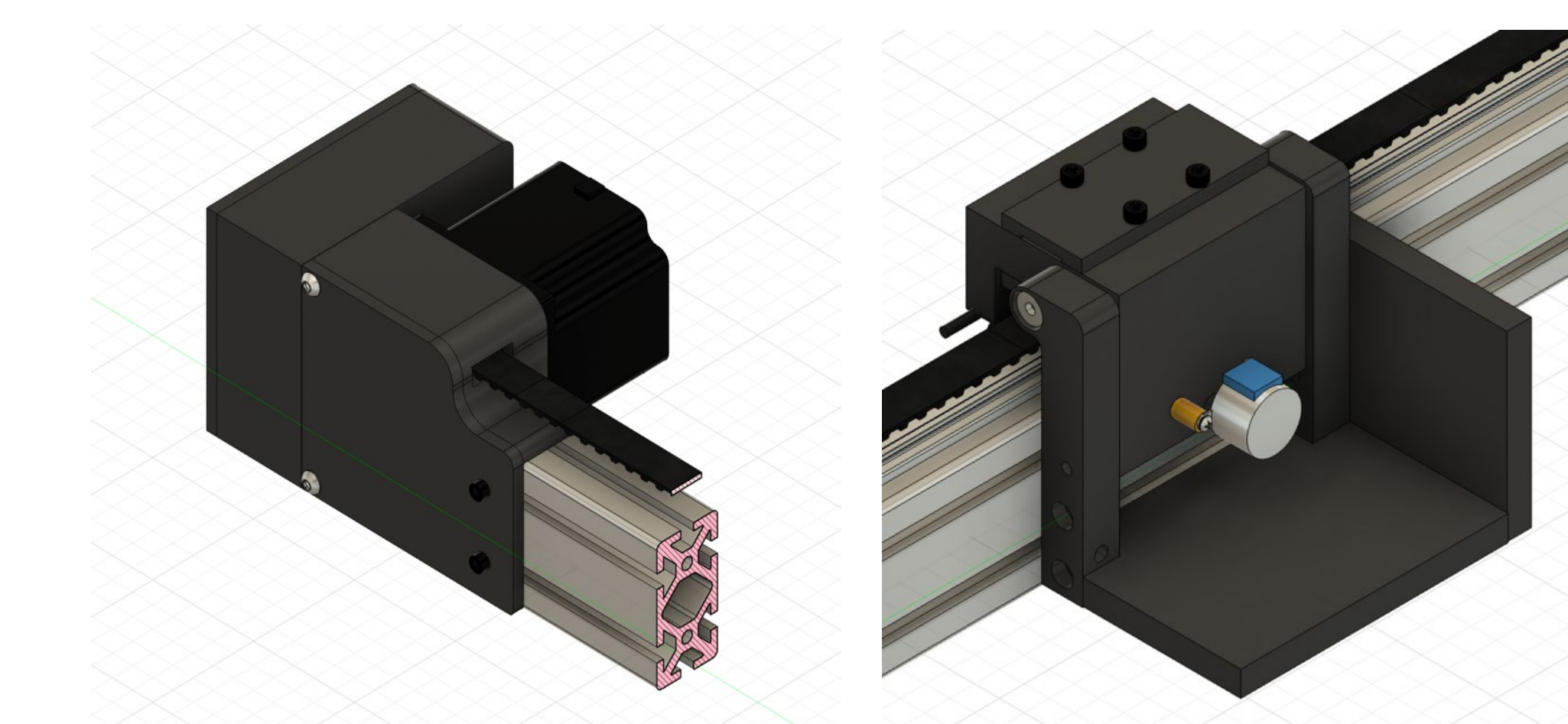
FINAL DESIGN



The Automated ProStop® Final Design



The Tensioning System and Housing



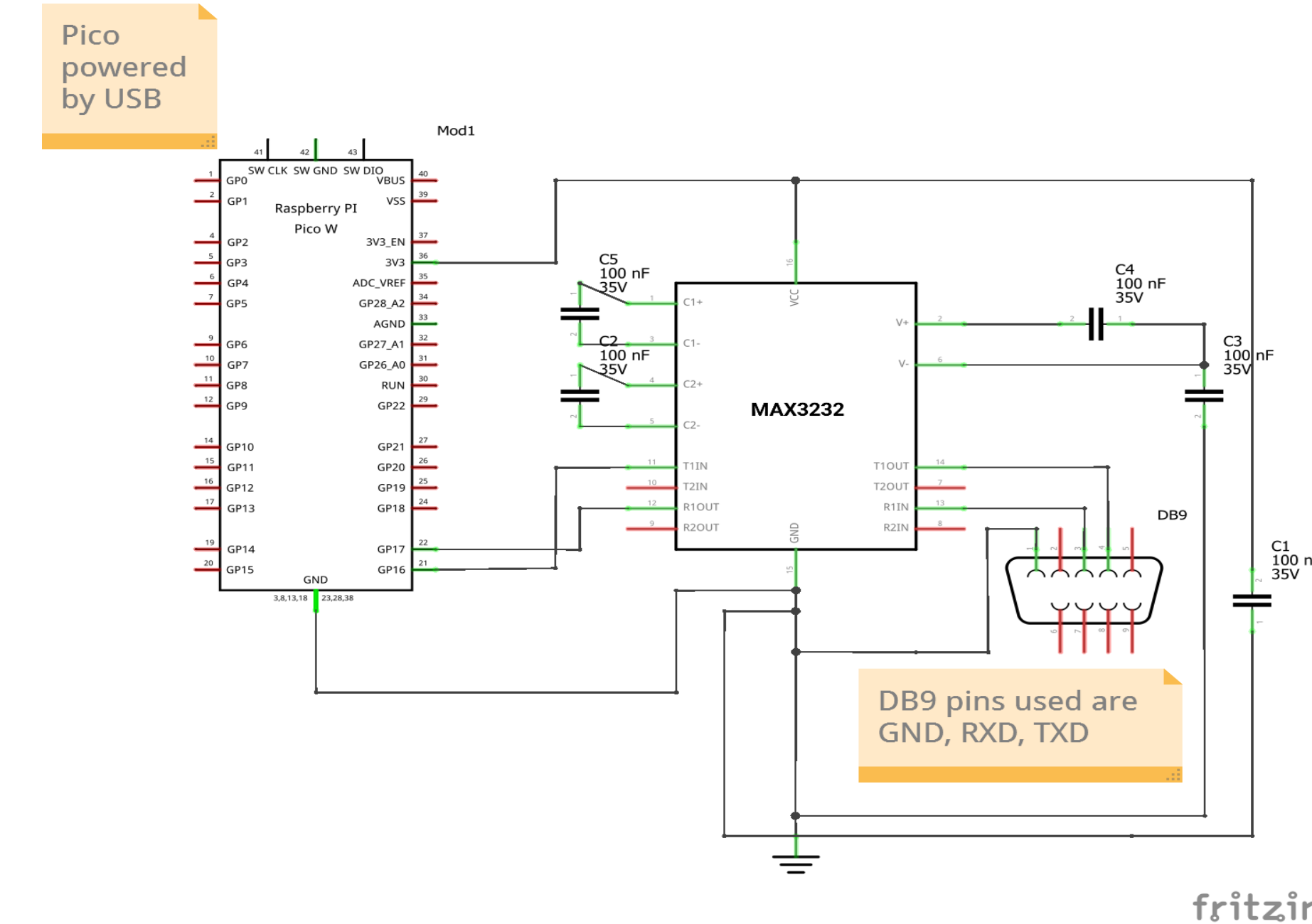
The Drive Housing, Motor and Moving Carriage

```

380 #Stepper Motors
381 #####
382 #this is only a basic full stepping.
383 #speed sets the length of the pulses
384 #50 is "backwards" - the fastest that works reliably with the motor used in the project is 8000us, but slower than that is good. tested to 20000us
385 # motor should be 1 or 2 - 1 is terminals for motor 1 and 2 on PCB, 2 is terminals for motor 3 and 4 on PCB
386
387 def step(self,motor, direction, steps, speed = 8000, holdPosition=False):
388
389     if (motor<1) or (motor>2):
390         raise Exception("INVALID MOTOR NUMBER") # harsh, but at least you'll know
391
392     if (direction == "F"):
393         directions = ["F", "F"]
394         coils = [(motor*2)-3,(motor*2)]
395     elif (direction == "R"):
396         directions = ["R", "R"]
397         coils = [(motor*2),(motor*2)-1]
398     else:
399         raise Exception("INVALID DIRECTION") #harsh, but at least you'll know
400     while steps > 0:
401         for direction in directions:
402             if (steps == 0):
403                 break
404             for coil in coils:
405                 self.motorOn(coil,direction,100)
406                 utime.sleep_us(speed)
407                 steps -=1
408             #coil = 1 - possible location for tracking cut per step
409             if (steps == 0):
410                 break
411         #to save power turn off the coils once we have finished.
412         #this means the motor won't hold position.
413         if(holdPosition == False):
414

```

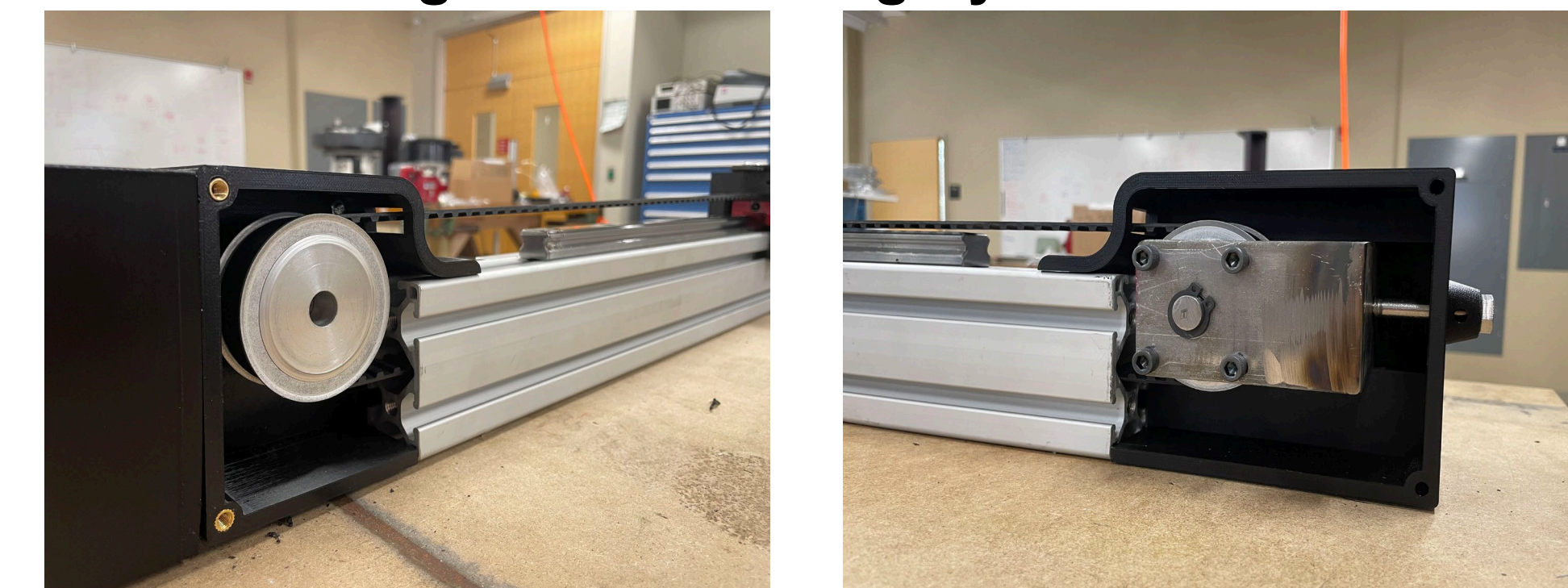
Stepper Motor Module Used in Project



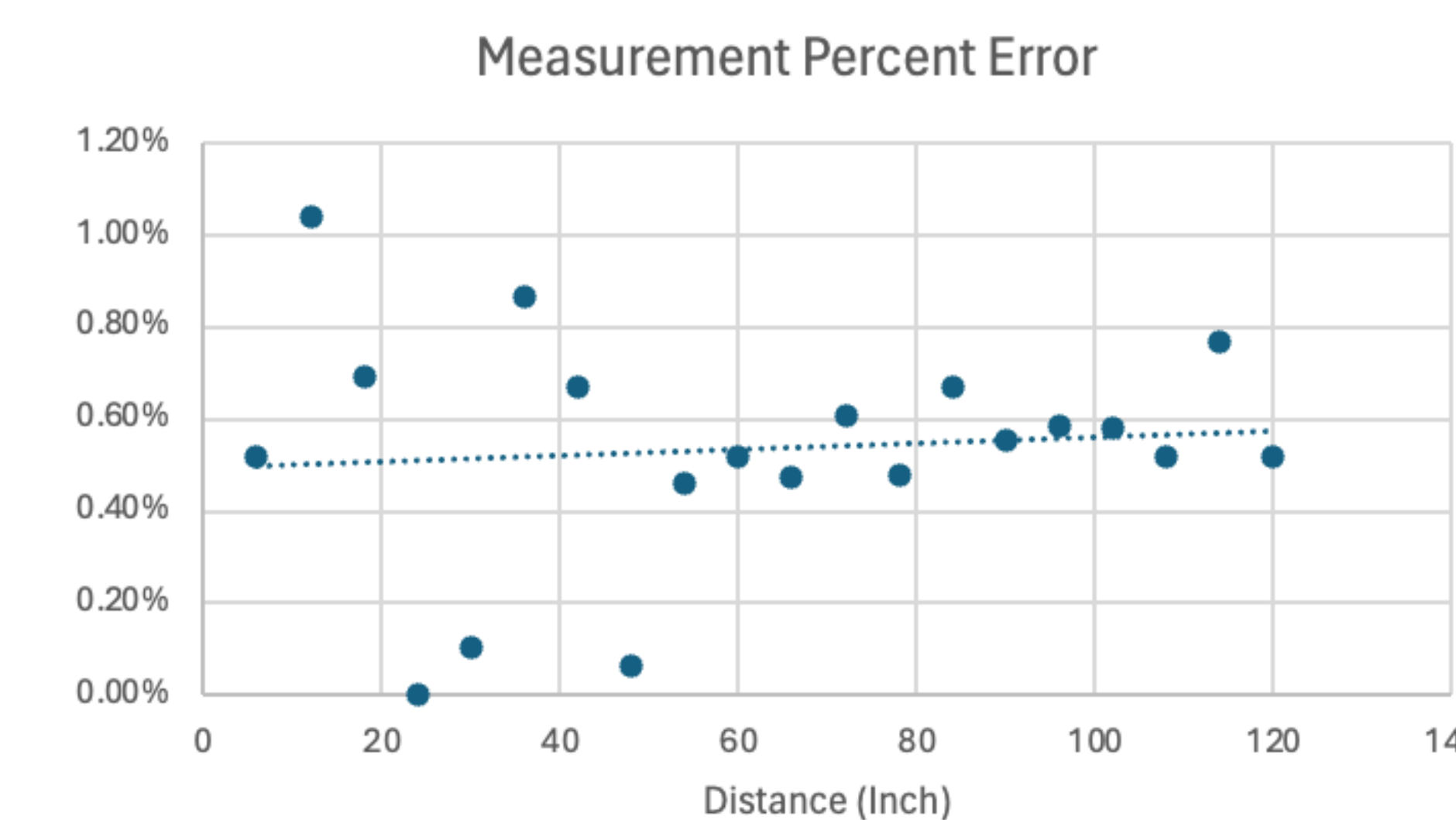
MAX3232 RS232-to-MicroController Signal Conversion Circuit

RESULTS

Drive Housing and Tensioning System



Measurement Results



Online Web Server/User Interface



SUMMARY AND CONCLUSIONS

Team 14 designed and built a prototype automated version of Accurate Technologies current ProStop®. A belt drive system was chosen to actuate the device. The user Interface which is coded in MicroPython intakes the data stream from the encoder and can send the desired position of the stop and compare it against the actual position..

The device actuates the stop across the entire length of the aluminum extrusion and functions adequately as a proof of concept. The Raspberry Pi Pico can receive and manipulate the closed-loop feedback system.

Software: Fusion 360, Creo Modeling, Thonny

FUTURE WORK

- Include protective measures for dust and debris
- Aluminum extrusion redesign for a fully enclosed system. Redesign for safety and device protection.
- Wire management system, cable carrier, and datum measurement function
- Improve user interface of webserver
- Improve manufacturability of housings
- Choose a better suited motor driver

TEAM & ACKNOWLEDGEMENTS

- Conrado Del Real (EE)
- Jacob Letterman (ME)
- Larry McCray (ME)
- Faculty Mentor: Dr. Hugh Jack
- Sponsor: Mike Fiantaca, Henry Fiantaca



Accurate
TECHNOLOGY INC.
Linear Digital Measuring Systems

References

1. <https://www.proscale.com/>
2. <https://www.cable-tester.com/rs232-pin-out/>
3. <https://github.com/KitronikLtd/Kitronik-Pico-Robotics-Board-MicroPython>