

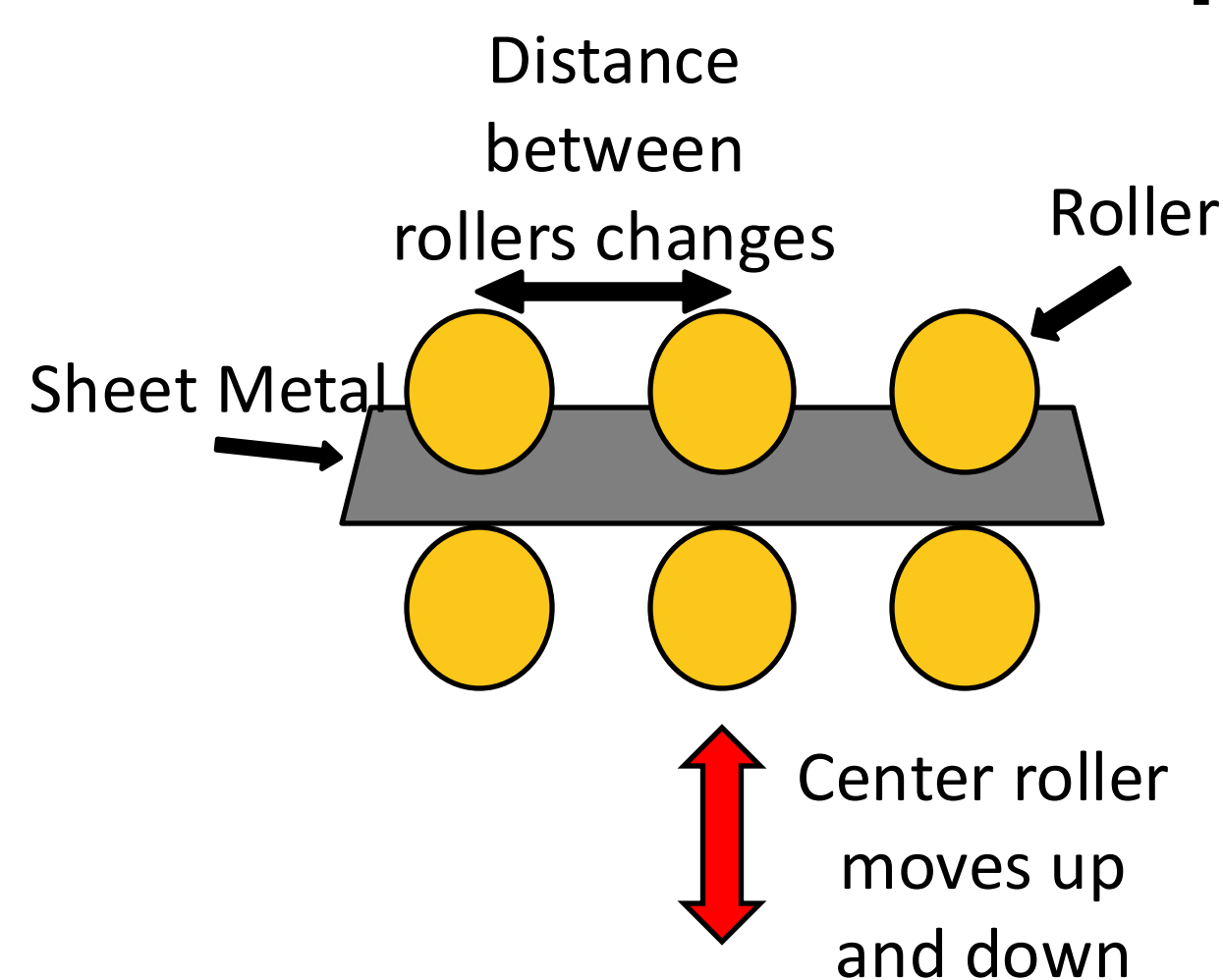
OBJECTIVE

Optimize an existing fatigue testing frame to evaluate the fatigue life of sheet metal at targeted locations. This project aims to support research on advanced sheet metal joining techniques and enable precise data collection on the number of cycles to failure.

VALUE PROPOSITION & BACKGROUND

Boost product reliability and longevity with fatigue durability solutions—preventing failures, accidents, and waste in competitive markets.

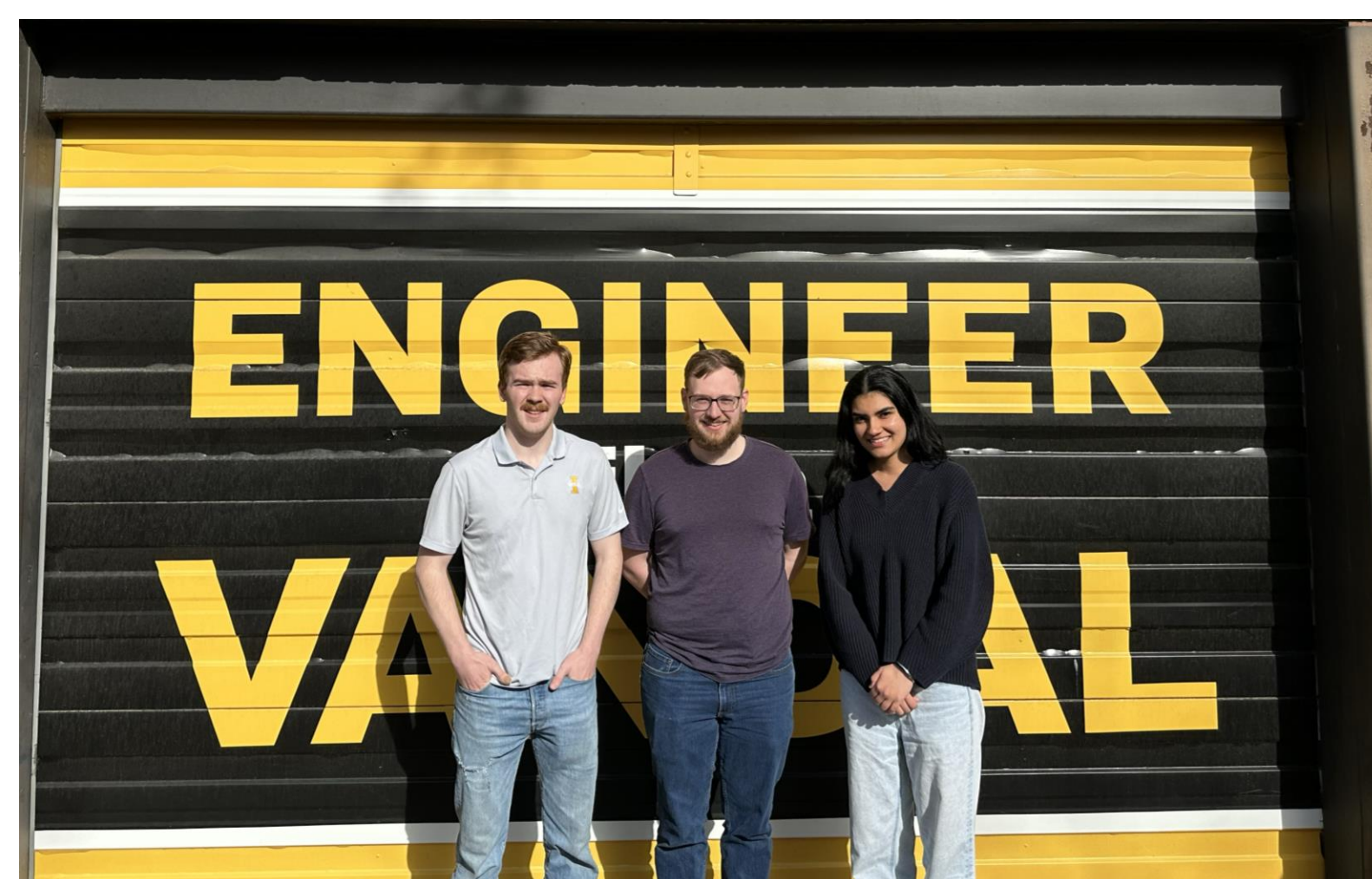
- Fatigue data for sheet metal is not well known
- Original machine is difficult to use and lacks accuracy/consistency



REQUIREMENTS

- Produce an S-N curve for Aluminum 5052 sheet metal material
- Improve reliability and confidence in data
- Detect when a sample breaks and automatically stop the machine
- Provide a more modular design for future researchers to be able to change things as needed

MEET THE TEAM



CONCEPT DEVELOPMENT

Piezoelectric Vibration Sensor

- Detects changes in plate vibration during break events
- Susceptible to external vibrations

Wheatstone Bridge Circuit

- Used to detect discontinuities
- Output Current is indistinguishable from signal noise

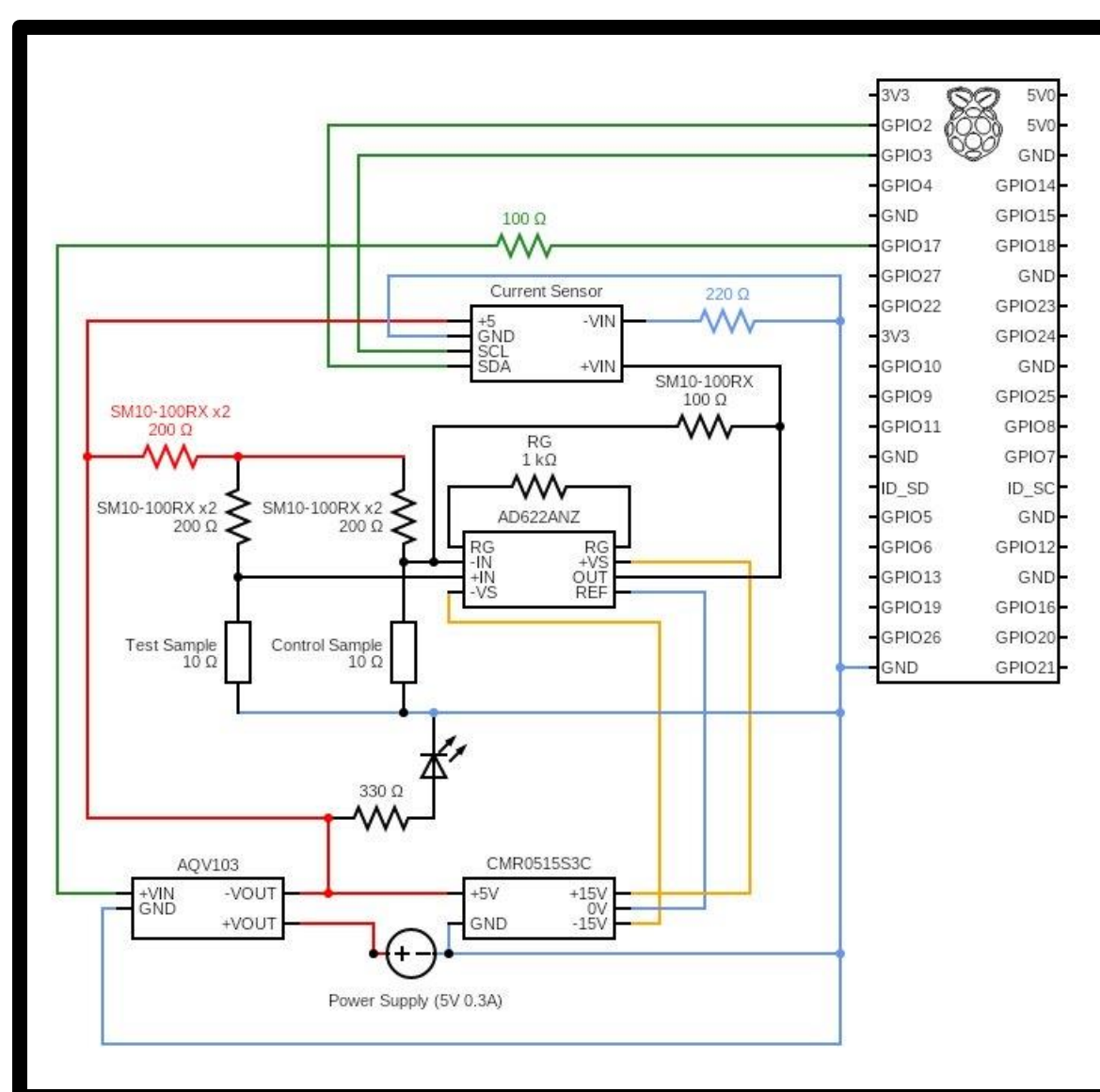
FINAL DESIGN

New Slide Assembly

- Set hole positions related to varying stress levels
- Jig for easy and accurate setup
- Modular plate design for easy replacement

Break Detection Circuit

- Pseudo-bridge circuit with an inverting voltage follower for balance and swing
- Detects discontinuities in test sample and automatically shuts off

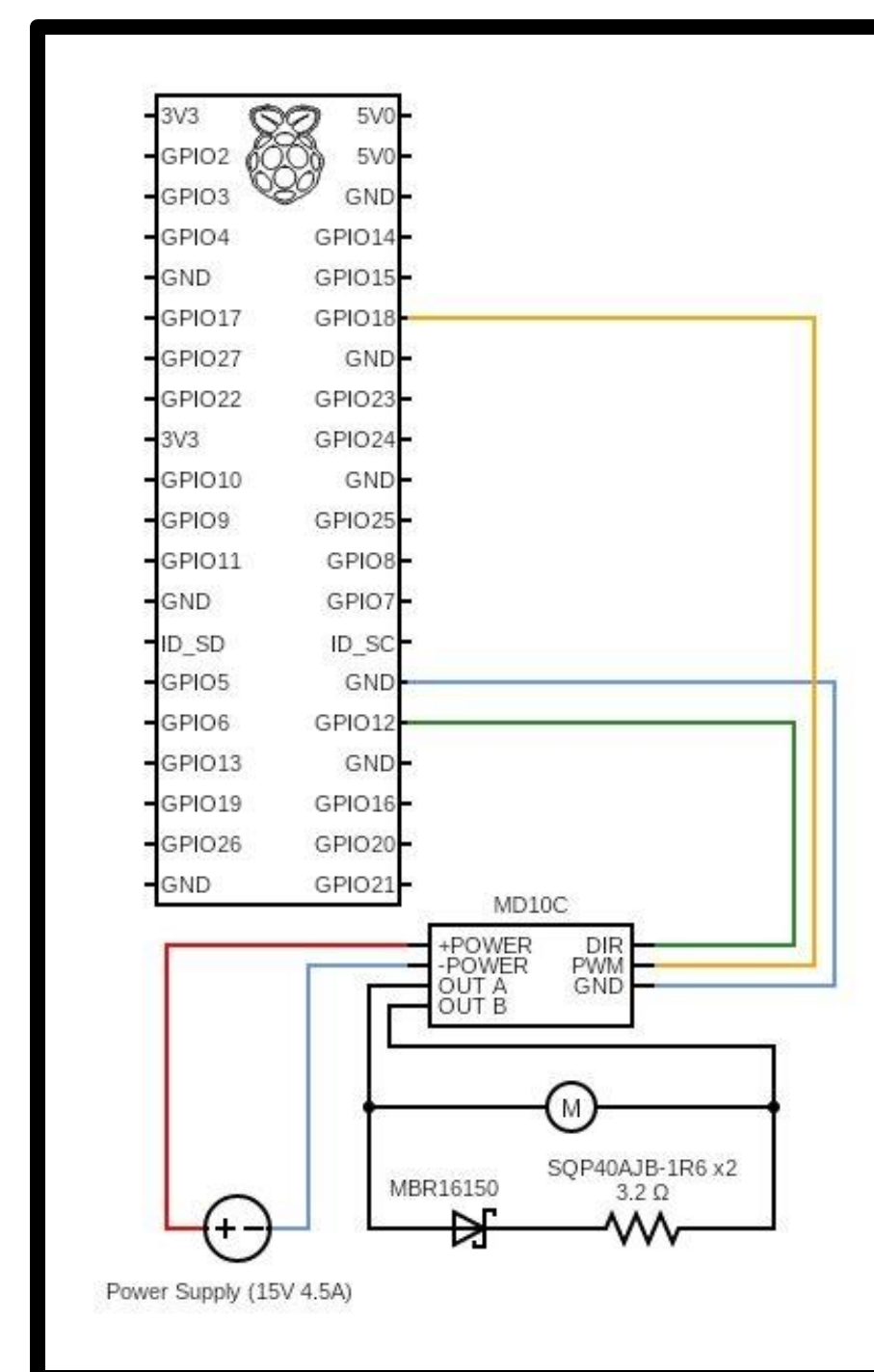
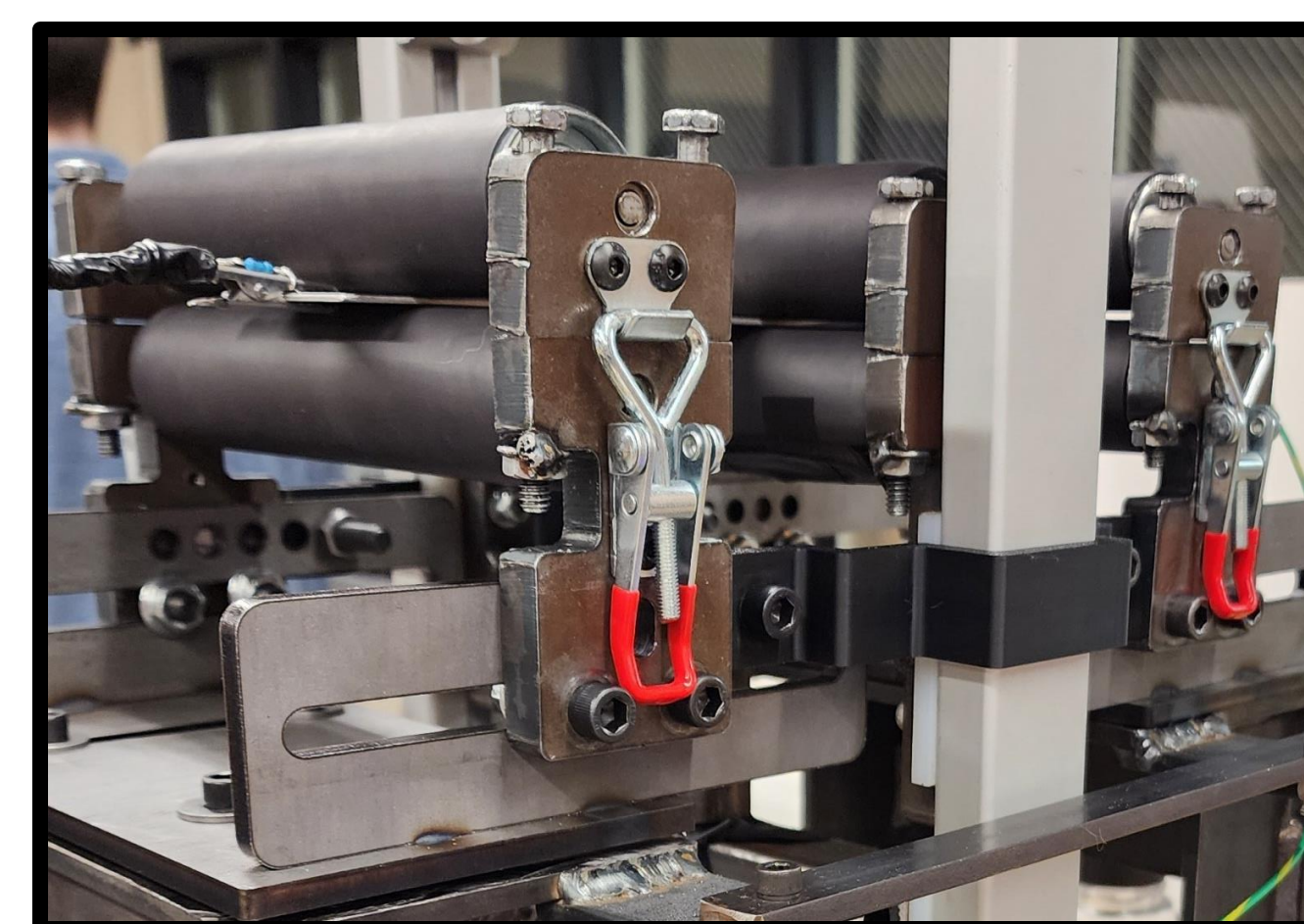
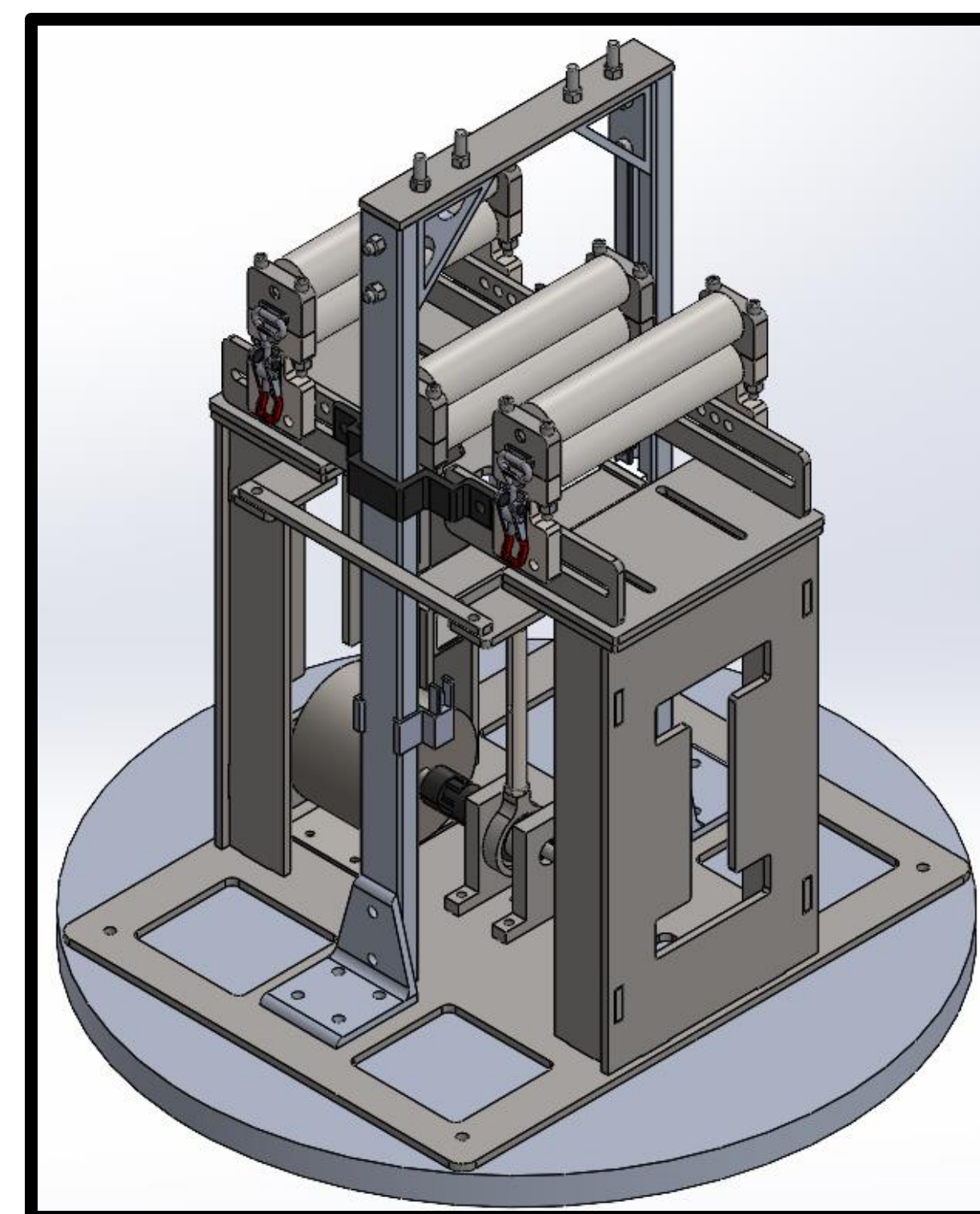


Flyback Protection Circuit

- Protects motor controller from motor induced voltage on shutoff

IR Break Beam Sensor

- Ensures accurate count of cycles

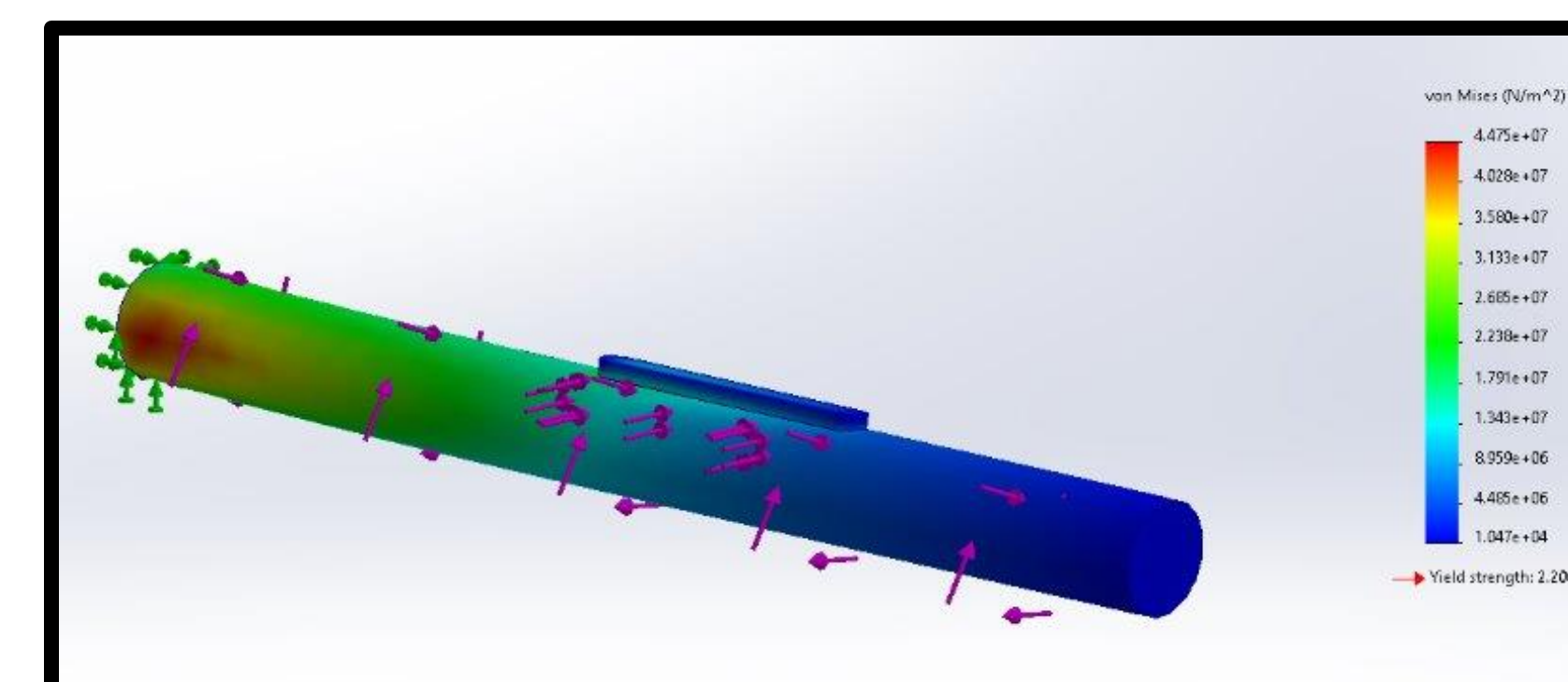


VALIDATION

- Simulated forces on new shaft
- Ran machine over night
- Marked lines before and after test to view any movement
- Recorded slow motion video to compare recorded vs actual cycles

RESULTS

- Shaft key would shear off preventing motor damage
- Sample remains within $\pm 0.5mm$ of targeted location
- Sample breaks detected within ± 3 cycles



CONCLUSION

- Acquired consistent data for 2 stress levels
- On startup, the machine independently collects cycle count, detects sample breaks, and writes data to file upon completion

ACKNOWLEDGEMENTS

- Dr. Matthew Swenson Client
- Ryan Sundburg Instructor/Mentor
- Shalom Masong SEL
- Jonathan Richards SEL