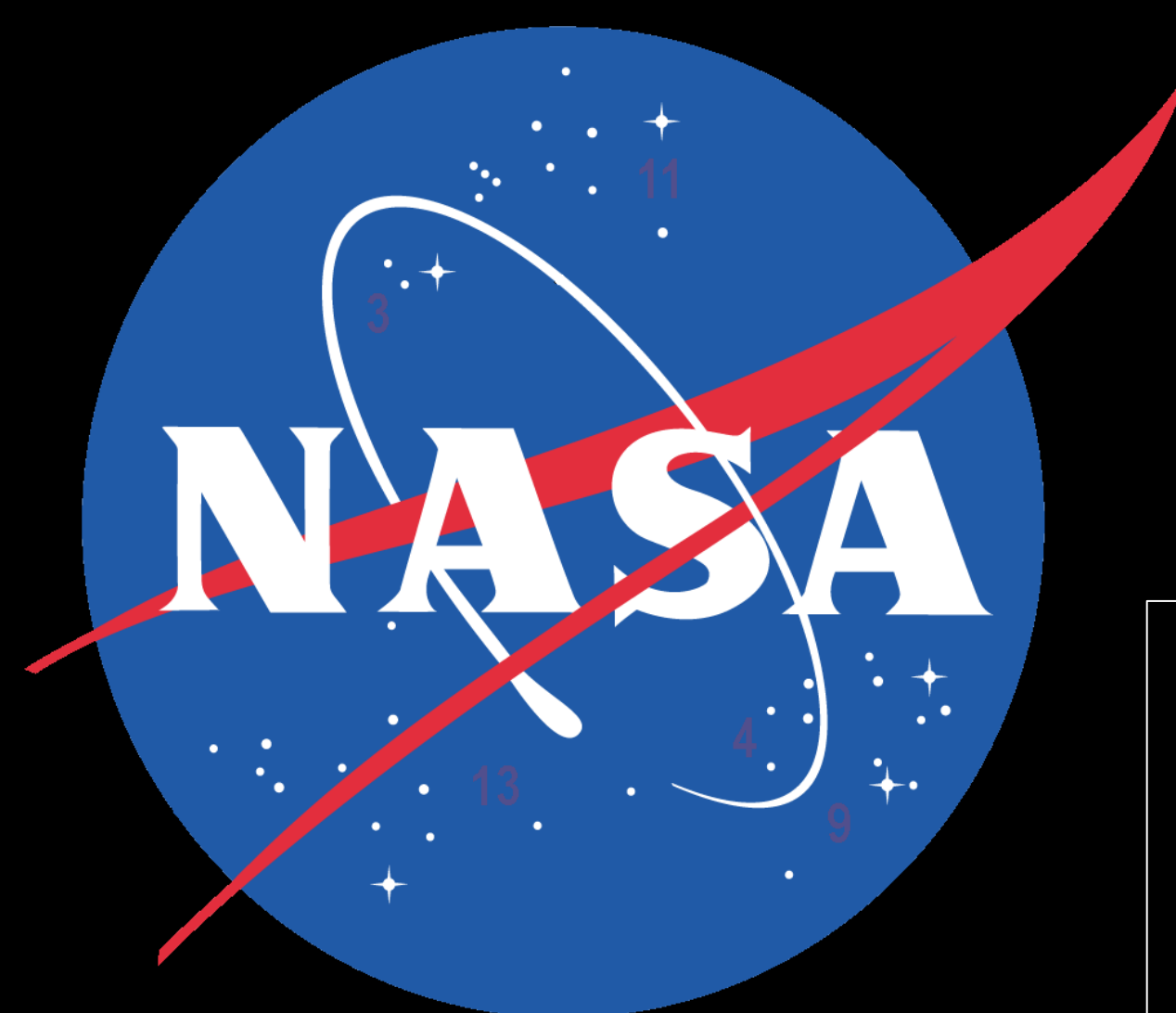




CRYOGENIC TENSILE TESTER

RYAN SUNDBURG (ME), KATHRYN REECE (ME), ETHAN HINKLE (COMPE),
SETH LUNDERS (CS), CHASE GORNICK (CS)



Introduction

Tensile testers are used to determine a material's properties, such as ultimate tensile strength, yield strength, and modulus of elasticity. Our goal is to create a user-friendly, inexpensive, and accurate way to test how materials behave in space-like conditions—specifically at temperatures as low as 100K.

Sub-System Objectives

User Interface

- Create a new user interface that is simple and easy to use.

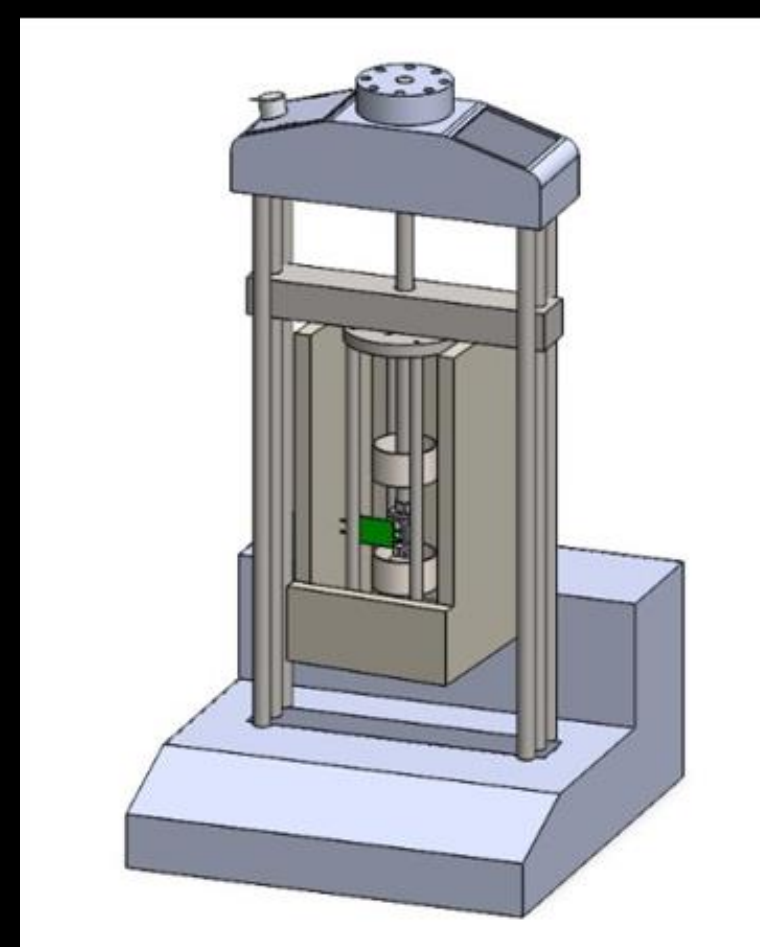
Data Acquisition

- Make improvements to the following sensors: rotary encoder and thermocouple.

Mechanical System

- Repair gearbox so the machine can successfully perform tensile tests.

Tensile Tester

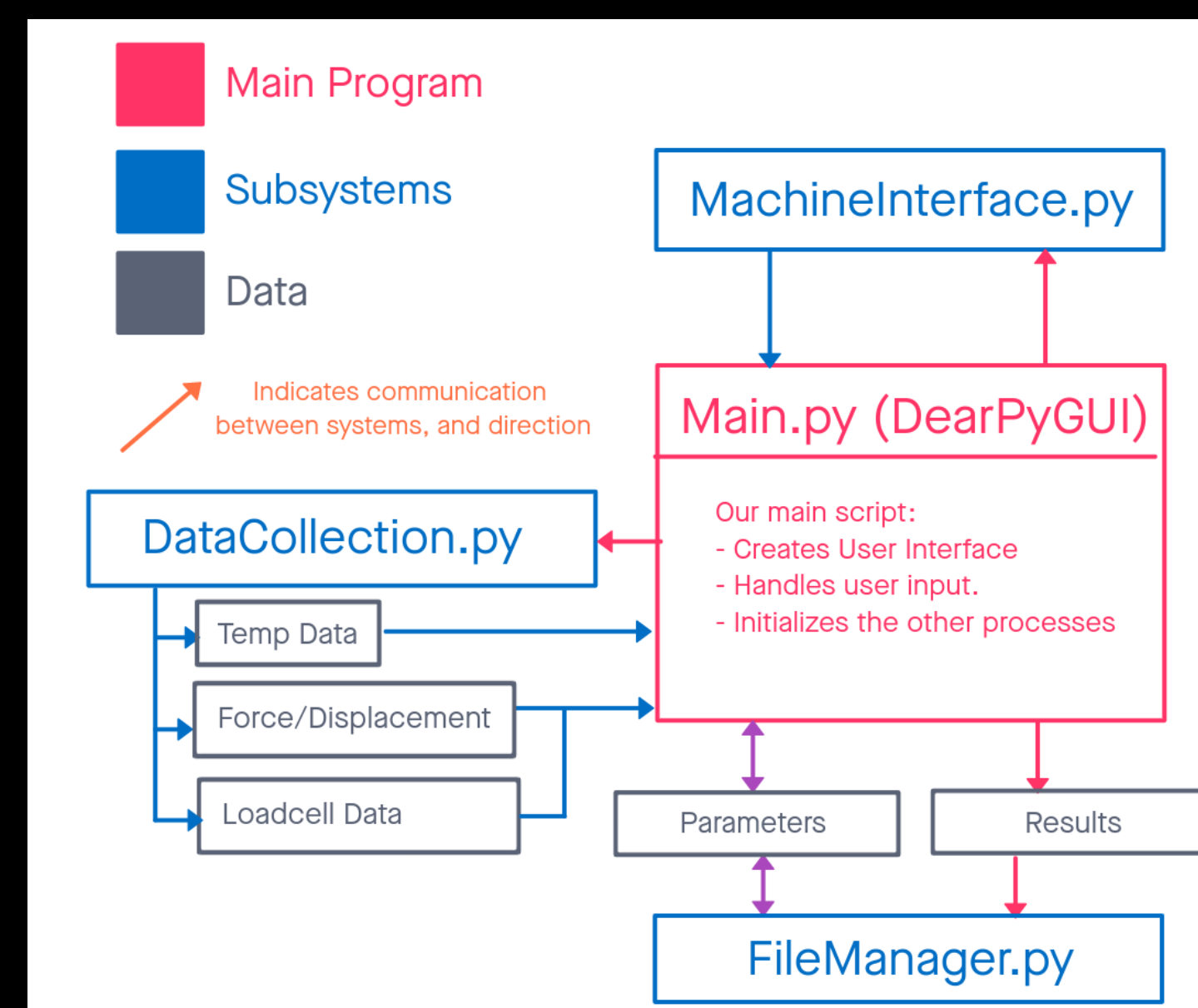


3D Model and photo of tensile tester frame.

Mechanical System

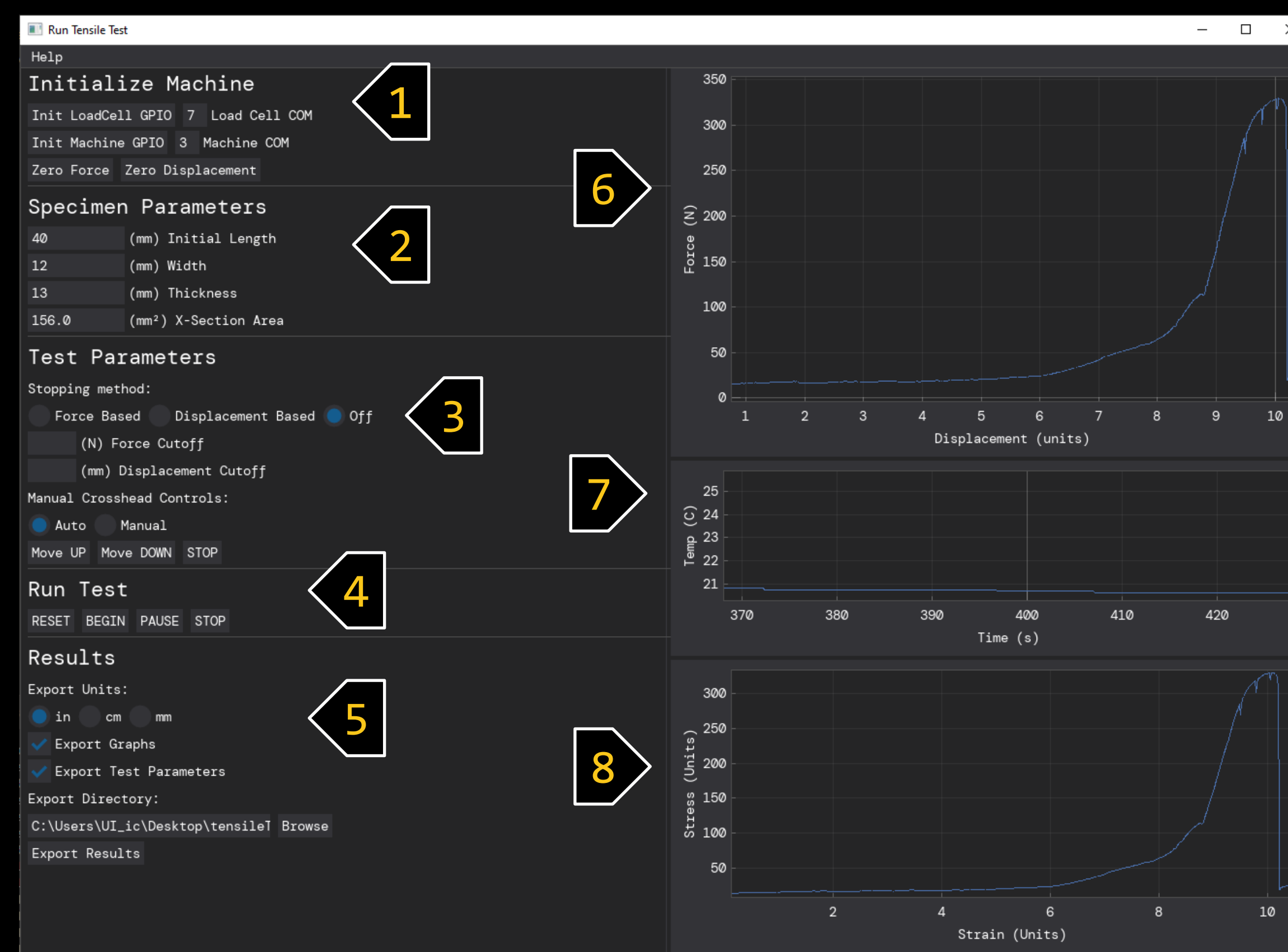
The gearbox was successfully reassembled and reinstalled. We determined the clutches could not be replaced without damage to the gearbox.

UI/Software Design



The user interface is built with DearPyGUI, a Python framework. It displays real-time data from the sensors and uses multiprocessing to ensure accurate data collection. The figure above shows a high-level view of the software design.

Final User Interface



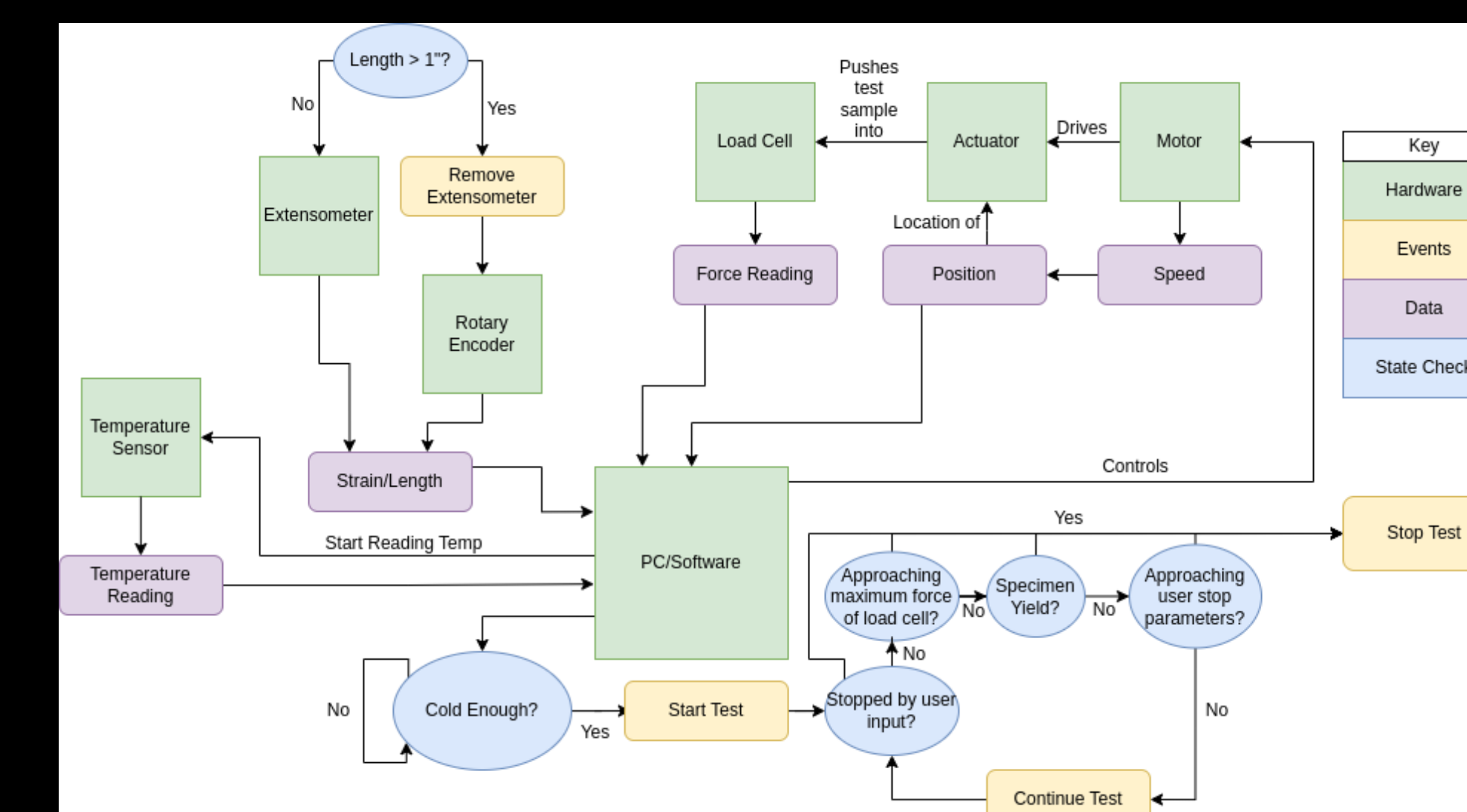
UI Components:

1:Machine/Sensor Initialization, 2:Specimen Parameters, 3:Test Parameters, 4:Test Controls, 5:Results/Export Settings, 6:Force/Displacement Chart, 7:Temperature/Time Chart, 8:Stress/Strain Curve

Data Acquisition Systems

- T-Type Thermocouple – Record temperatures as low as -173C (100K) and output to GUI.
- Rotary Encoder – Record the displacement of the tested sample in 0.0014" increments.
- Load Cell – Record load cell forces for stress/strain analysis.

Control Flow Diagram



The flow of commands and actions of an operational test.

Design Validation

- Perform user testing of new user interface.
- Test against known values to calibrate and confirm findings of the tester.

Future Additions

- Reintegrate extensometer for more accurate testing for small tests.
- Replace motor/gearbox to allow for variable speed options.

Acknowledgements

We would like to thank Dr. Maughan, Dan Revard, Kevin Sikes, and NASA Idaho Space Grant Consortium for their contributions to this project.



2023 Capstone Project