Improved Uniaxial Tensile Strength Tester

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Problem Statement

- The University at Albany's chemistry department, as part of their educational mission, intends to build a laboratory for undergraduate students where they can gain hands on experience testing various material properties (including tensile strength). However, due to the extremely high cost of commercial products they have been unable to equip such a laboratory.

- The goal of this project is to build an accurate, low cost, easy to use uniaxial tensile strength tester to support this educational mission.

System Requirements

- **System Accuracy:** The system should be able to accurately measure the stress-strain curve, such that Young's Modulus and Ultimate Tensile Strength can be calculated to within two significant figures.

- **System Ease-of-Use:** The system should be easy to calibrate and operate by undergraduate students without requiring knowledge of electronics or software programming.

System Components & Budget

Part	Purpose	Cost
Laser Ranging Module Sensor	Measures Distance	$16.80
Rope	Stretch Material	$6
Pulling Winch	Uniform Pull	$31.31
3D Prints	Controls System	$0
	TOTAL	$54.11

Project Partners

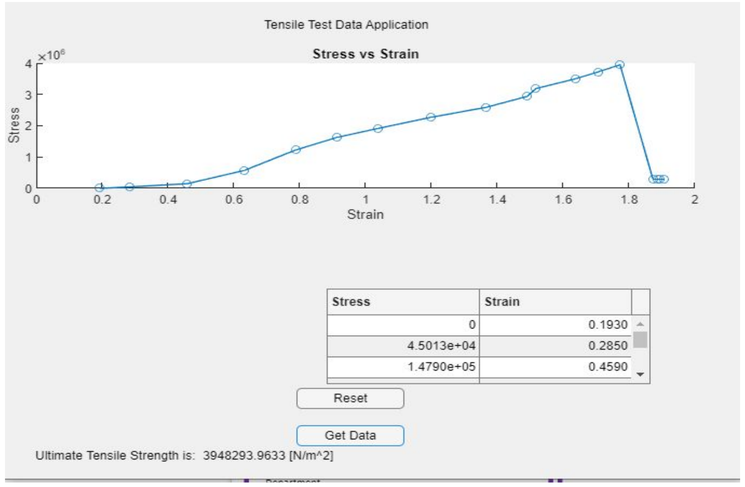
- Special thanks for Professor Chen, Feldblyun, Yeung, and the University at Albany's Chemistry Department for sponsoring this project.
- This project was developed in ECE442: *Systems Analysis & Design* in the Electrical & Computer Engineering Department.

Experimental Results

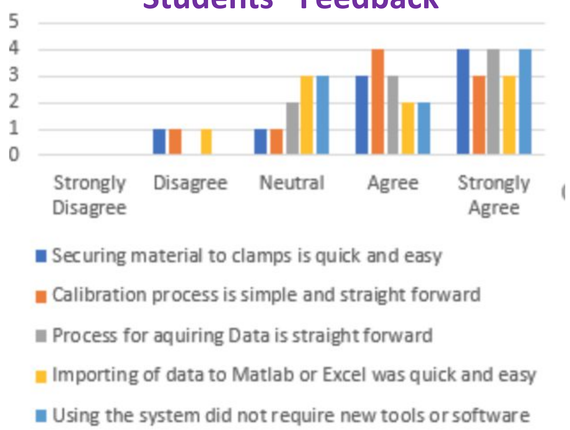
System Accuracy

Metric	Sample	Our System	Known Value	Error
Young's Modulus	Latex	572 ± 136 kPa	740 ± 10 kPa	22%
…	Nitrile	1.5 ± 1.1 MPa	2.4 ± 0.2 MPa	37.5%
Ult. Tensile Strength	Latex	2.7 ±1.2 MPa	3.3 ± 0.1 MPa	18%
…	Nitrile	4.9± 1.3 MPa	4.4 ± 0.1 MPa	11%

Stress-Strain Curve



Students' Feedback



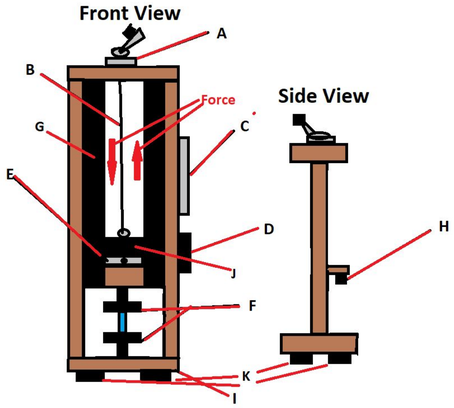
System Design

Key System Features

To satisfy system requirements, we incorporated the following design modifications:

- **Item #1**: **Laser Ranging Module Sensor**, measures accurate distance.
- **Item #2: Pulling Winch**, creates a uniform pull.
- **Item #3: 3D printed Clamps**, easy to attach material to the system.
- **Item #4: 3D printed Rails**, reduces friction when pulling the material.
- **Item #5: 3D printed Feet**, creates a stable platform for the system.

Physical Model



A: Pulling Winch B: Rope C: Breadboard
D: Arduino Uno E: Load Cell 5kg F: 3D printed clamps
G: 3D printed rails H: VL53L1X Laser Distance Sensor I:Tensiometer
J: 3D printed block K: 3D printed Feet

Circuit Schematic