Material Tensiometer

Jebadiah Parillo, Alexander Rotariu, Hiroaki Nakahara, Alistair Clement Talaboc

Department of Electrical & Computer Engineering, University at Albany

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
Ultrasonic Range Sensor	Measures Distance	$4
S-Type Load Cell (5kg)	Measures Force	$36
Amplifier Board	Amplifies and Digitizes Signal	$10
Microcontroller	Controls System	$15
Push Pull Force Fixtures	Secures Test Material	$45
12V DC Geared Motor	Automates Material Stretching	$16
DC Motor Speed Controller	Controls Motor	$12
Flange	Enables Motor To Stretch	$8
	TOTAL	**$146**

Project Partners

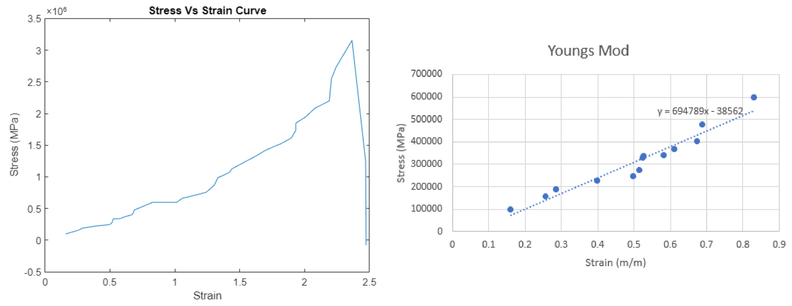
- Special thanks for Professor Chen, Feldblyun, Yeung, and the University at Albany's Chemistry Department for sponsoring this project.
- This project was developed in ECE442: *Systems Analysis & Design* in the Electrical & Computer Engineering Department.

Experimental Results

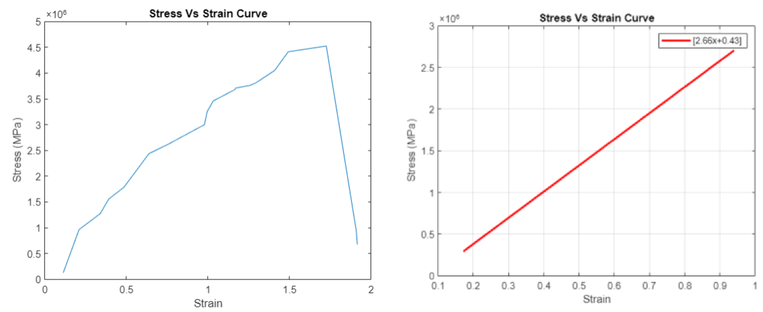
System Accuracy

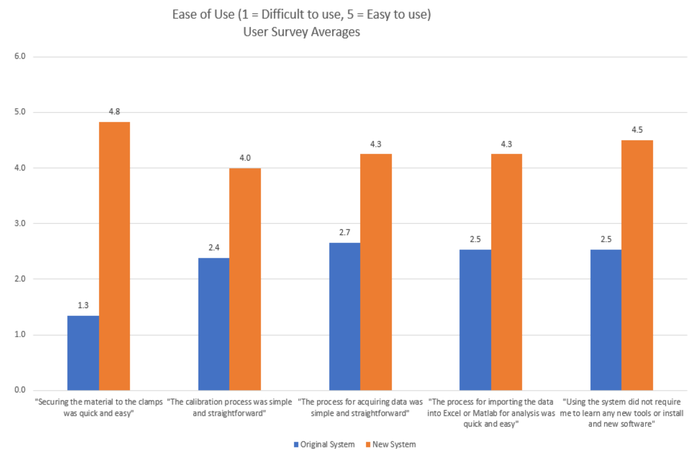
Metric	Sample	Our System	Known Value	Error
Young's Modulus	Latex	694± 20 kPa	740 ± 10 kPa	6%
…	Nitrile	2.66±0.5 MPa	2.4 ± 0.2 MPa	10%
Ult. Tensile Strength	Latex	3.57±0.2 MPa	3.3 ± 0.1 MPa	8%
…	Nitrile	4.48±0.3 MPa	4.4 ± 0.1 MPa	2%

Latex Stress Strain Curves



Nitrile Stress Strain Curve & Youngs Modulus





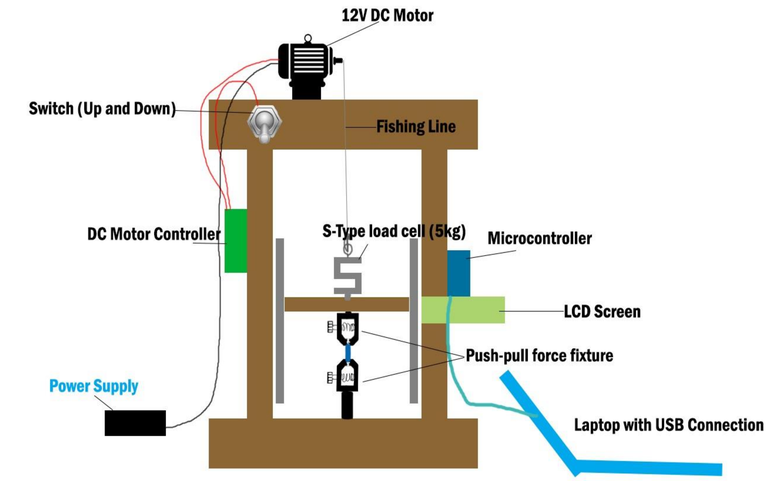
System Design

Key System Features

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

- **12V DC Motor**: Automatically induces tension on material
- **Push-Pull Force Fixture:** Easily secure material to be tested
- **S-Type Load Cell:** Measures the load on stretched material
- **LCD Screen:** Displays load and distance of material live to user
- **Up and Down Switch:** Allows user full control of tension on material

Physical Model



Circuit Schematic