Automatic Uniaxial Tensiometer

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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
Stepper Motor	Automates straining of material, measures Distance	$65
Metal Clamps	To hold material	$19
Load Cell 20kg HX711	Measures Force/Stress	$10
Kevlar Fishing Line	Ropes to pull clamps	$8
16x2 LCD Screen	Displaying the results	$16
	TOTAL	$118

Project Partners

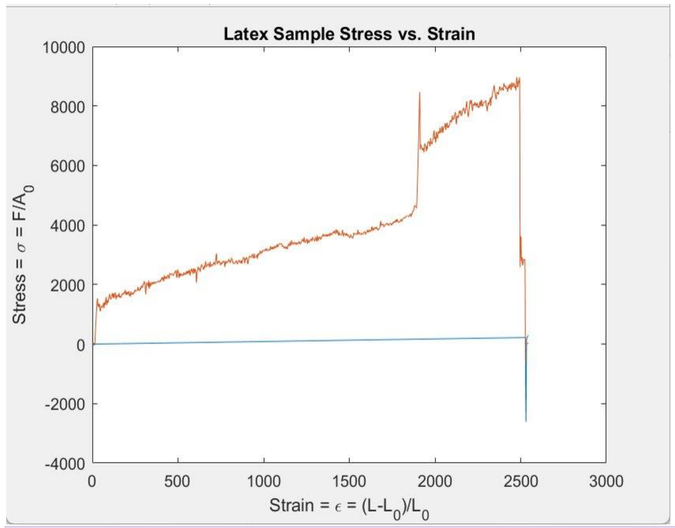
- Special thanks for Professor Chen, Feldblyun, Yeung, and the University at Albany's Chemistry Department for sponsoring this project.
- This project was developed in ECE442: *Systems Analysis & Design* in the Electrical & Computer Engineering Department.

Experimental Results

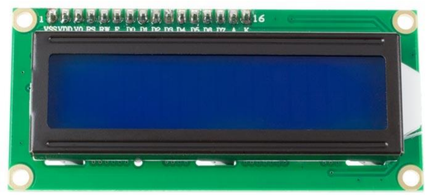
System Accuracy

Metric	Sample	Our System	Known Value	Error
Young's Modulus	Latex	± 700 kPa	740 ± 10 kPa	± 5.54%
…	Nitrile	± 2.1 MPa	2.4 ± 0.2 MPa	± 12.5%
Ult. Tensile Strength	Latex	± 3.5 MPa	3.3 ± 0.1 MPa	± 6.06%
…	Nitrile	± 4.1 MPa	4.4 ± 0.1 MPa	± 6.81%

Stress-Strain Curve



<- Clamps



LCD Screen

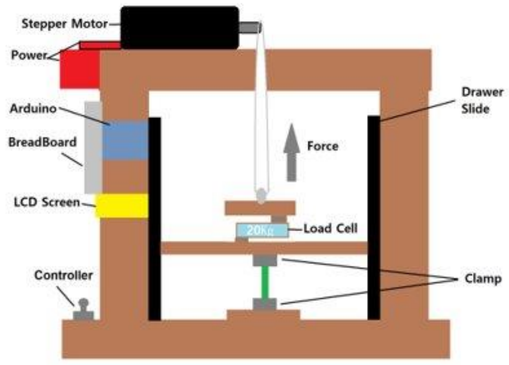
System Design

Key System Features

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

- **LCD Screen:** Easy use for the users to collect data and have a simple GUI.
- **Automated Stepper Motor:** A high-precision stepper motor is used in place of a manual crank system reducing user fatigue as well as providing precise results.
- **Clamps:** Simple, reliable, and easy to use clamp design for further ease of operation.
- **Reliability:** Redundancy as well as implementing low-cost and low-tech design changes vastly improves reliability.

Physical Model



Circuit Schematic