Team 11's Tensile Tester

Kaleb Bogardus, Mariela Monterroso, Kareem Abdeltawab, Elijah Lallemand
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
Stepper Motor	Measures Distance	$24
Load Cell 20kg With Amplifier Board	Measures Force	$10
String	Thinner string for system	$3
Power Supply	Provides the Necessary Power	$17
Motor Controller	Driver for the Motor	$11
Switch	Starts/Stops Rope	$9
LCD/I2C	Displays a UI for the user	$13
Wing Nuts	8 Wing nuts reinforce clamps	$5.99
	TOTAL	$84

Project Partners

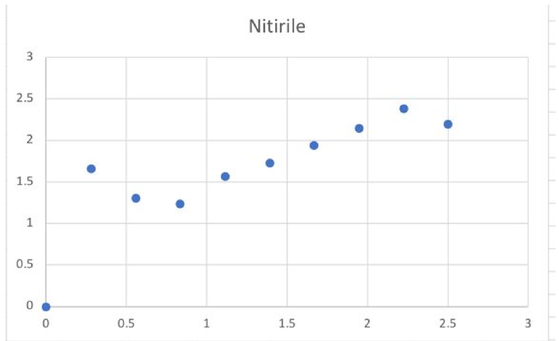
- Special thanks for Professor Chen, Feldblyun, Yeung, and the University at Albany's Chemistry Department for sponsoring this project.
- This project was developed in ECE442: *Systems Analysis & Design* in the Electrical & Computer Engineering Department.

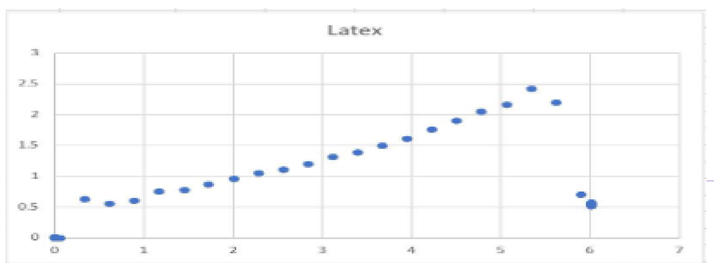
Experimental Results

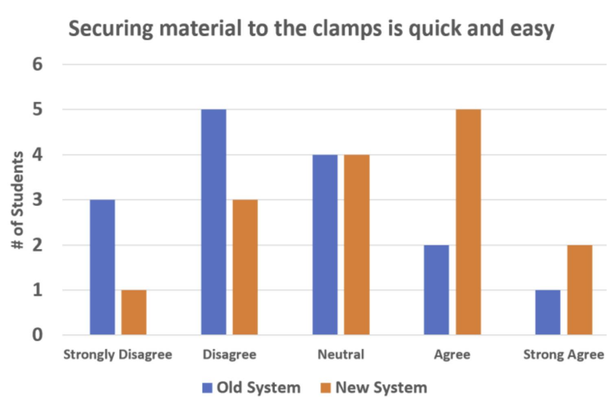
System Accuracy

Metric	Sample	Our System	Known Value	Error
Young's Modulus	Latex	1891.7	740 ± 10 kPa	155%
…	Nitrile	5.92	2.4 ± 0.2 MPa	146.66%
Ult. Tensile Strength	Latex	2.422	3.3 ± 0.1 MPa	24%
…	Nitrile	2.38	4.4 ± 0.1 MPa	45.9%

Stress-Strain Curve







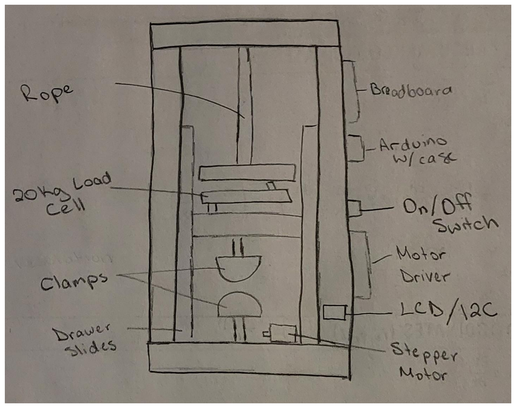
System Design

Key System Features

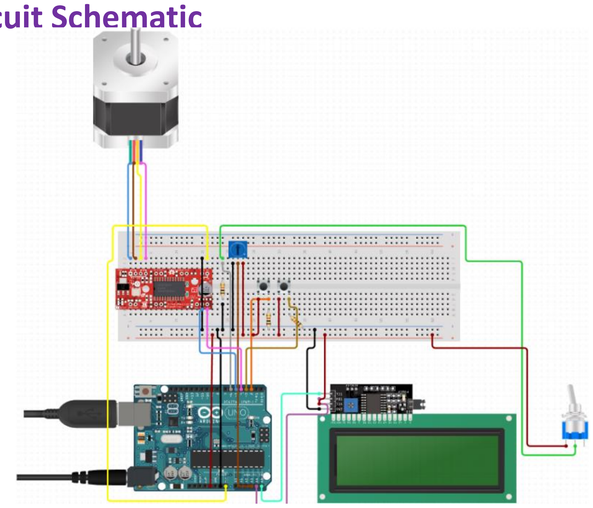
To satisfy system requirements, we incorporated the following design modifications:

- **Stepper Motor**: Increase accuracy of distance
- **20kg Load Cell:** Increases load capacity
- **Switch:** Allows start/stop of rope winding
- **LCD/I2C:** Allows communication between peripherals (load cell, LCD) and controller for data measurement.

Physical Model



Circuit Schematic



This system uses a micro controller to control its components. There is a driver to power and control the motor. The motor moves back and forth with a 3-way switch. The user has 3 buttons to navigate the systems menu on the LCD and to control the system.