Improved 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
Ultrasonic Range Sensor	Measures Distance	$4
Load Cell 20kg	Measures Force	$4
Amplifier Board	Amplifies and Digitizes Signal	$3
Microcontroller	Controls System	$18
Crank/ Pulleys	Apply Even Stress	$40
LCD Screen	Ease Operation	$6
Wood/Fasteners	Frame Construction	$20
	TOTAL	**$95**

Project Partners

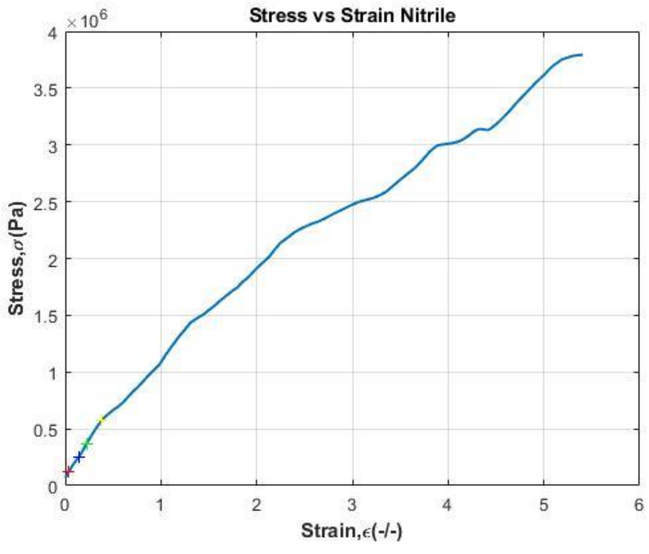
- Special thanks for Professor Chen, Feldblyun, Yeung, and the University at Albany's Chemistry Department for sponsoring this project.
- This project was developed in ECE442: *Systems Analysis & Design* in the Electrical & Computer Engineering Department.

Experimental Results

System Accuracy Compared to Ideal Values

Metric	Sample	Our System	Known Value	Error
Young's Modulus	Latex	604 ± 10 kPa	740 ± 10 kPa	18.3%
…	Nitrile	1.6 ± 0.2 MPa	2.4 ± 0.2 MPa	33.3%
Ult. Tensile Strength	Latex	3.5 ± 0.1 MPa	3.3 ± 0.1 MPa	6.06%
…	Nitrile	3.8 ± 0.1 MPa	4.4 ± 0.1 MPa	13.6%

Stress-Strain Curve Produced by Our Tensiometer



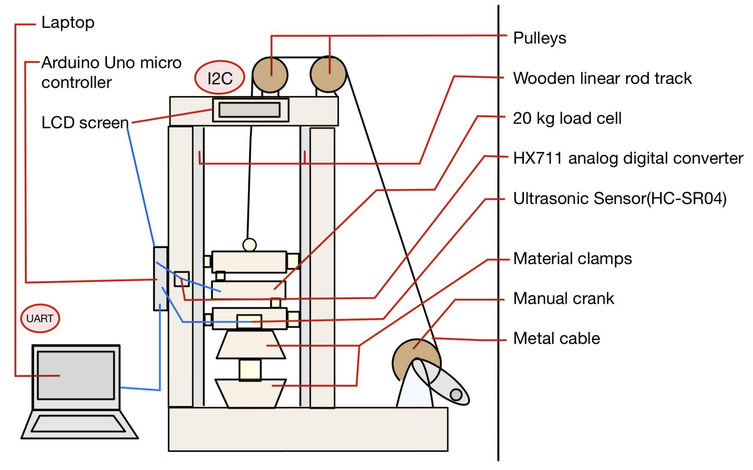
System Design

Key System Features

The following features were implemented to satisfy the system requirements:

- **Item #1**: Inexpensive linear guide rail
- **Item #2:** Hand crank and pulleys to apply uniform force
- **Item #3:** LCD screen to provide clear information and useful instructions
- **Item #4:** Durable design using sturdy materials and manual components
- **Item #5:** Intuitive easy to use material clamps

Physical Model



Circuit Schematic