Experimental Results (E+M^2)

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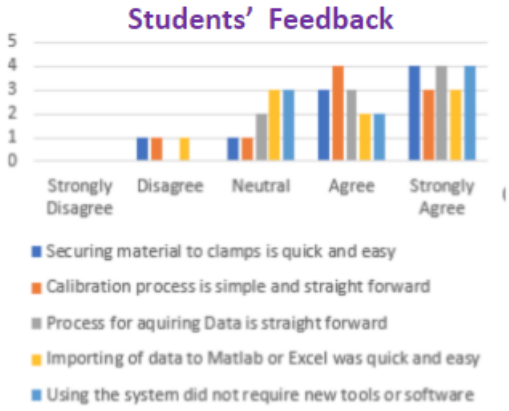
Activity Report

1 Research Question

The primary goal of this is to make the tensile tester easier to use. The first change was to switch the clamps. This was done by making a 3d model for a clamp then printing it. The 3d model for this clamp uses only two screws to hold onto the material. When comparing the previous clamp witch used several screws, the 3d printed clamp is much simpler to use.

The second change that was made to make the tensile tester easier to use was adding a winch(hand crank). Prior to the winch the user would have to hand pull the rope at a uniform speed to get good results. However with a winch the user only needs to turn the winch at a uniform speed speed, this change also removes some human error in the data.

The third change was the use of a Matlab app that makes the graph for the user. This script reads data from a .csv or .xlvx file and outputs a graph. This app is able to be used on any windows device, without having MatLab installed. Prior to this the user would have to sort through serial monitor data and convert the distance and load data into a Stress vs. Strain graph. Now the user only needs to record the load and distance data then using the given tool (ArduSpreadsheet) in the ArduinoUno application make a .csv file and save to desktop. Afterwards the user would only need to launch the Mathlab Application and enter the appropriate data(Thickness and width). Though this sounds long it only takes about 5 or less minutes to complete these steps. It takes about 20 minutes otherwise to get the graph data.



2 Experimental Results

Show the following results of your system.

1) Stress-strain curve for latex glove (See Figure 1).
2) Stress-strain curve for nirile glove (See Figure 2).
3) Table summarizing key metrics (Young's Modulus and Ultimate Tensile Strength) derived from stress-strain curves compared to known values from the original research paper (See Table 1). 'I

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After three testing trials, the stress-strain curve for latex glove shows that the improved

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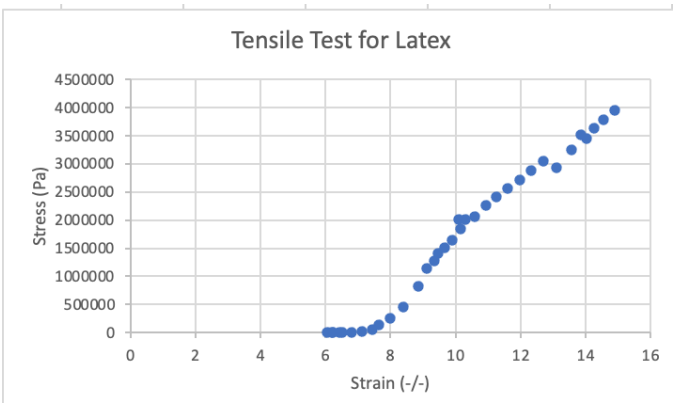

Figure 1. Stress-strain curve derived from our system for Latex glove sample

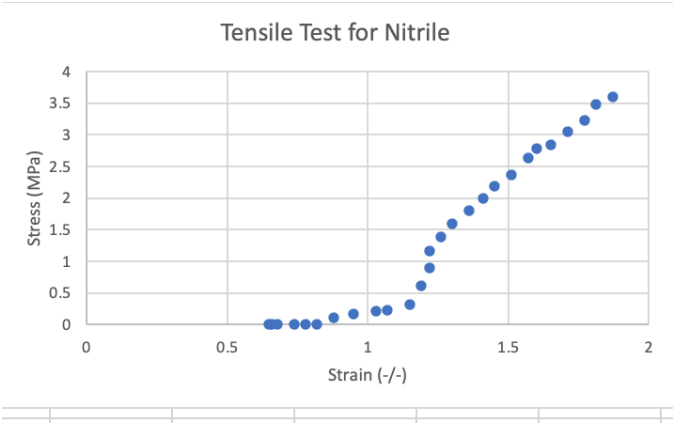

Figure 2. Stress-strain curve derived from our system for nitrile glove sample

system value for Young's Modulus was found to be 564 kPa. For the nitrile glove, the Young's Modulus value was 2.3 MPa.Comparing these values to the known value, the error was 0.23 for the latex glove and 0.04 for the nitrile glove.The Ultimate Tensile Strength derived from stress-strain curve for latex glove was 3.6 MPa and for the nitrile glove the value was 4.8MPa.Comparing these values to the known value, the error was 0.09 for the latex glove and 0.09 for the nitrile glove.

3 Data Analysis

Given the results for the previous section, the results from the experiment are within an order of magnitude that of the known values of Young's Modulus and Ultimate Tensile Strength. Although, as you can see that the results of this experiment are not as accurate as they should be, the values need to be further improved on with more thorough calculations with the code being used to calculate the stress-strain curve. Based on the results of the experiment, adding the laser distance sensor, the pulley winch system, and the guides to the tensile machine greatly improved the process of calculating a stress-strain curve. The laser distance sensor made finding the strain much easier because it lead to a more accurate way to find the distance. With that being said, so did the pulley winch system, which lead to a more uniform way to stretch the material and thus having a more accurate way to find the stress-strain curve. The 3D printed slides that are on the inside of the tensiometer also decreased the resistance that the original slides created when stretching the material. But, with that being said that all of the parts added to the machine were effective and none were not necessary, because without the parts that were added to the base design of the tensiometer the process of finding the stress-strain curve would be a much harder process. One thing that was learned through the process of making the tensiometer is to always attempt to make something work and to learn from the mistakes to greatly improve the overall system at hand.

Metric	Sample	# Trials	Our System	Known Value	Error
Young's Modulus	Latex Glove	3	564 ± 9.2 kPa	740 ± 10 kPa	0.23 ± 0.08
..	Nitrile Glove	3	2.3 ± 1.5 MPa	2.4 ± 0.2 MPa	0.04 ± 6.5
Ultimate Tensile Strength	Latex Glove	3	3.6 ± 2.4 MPa	3.3 ± 0.1 MPa	0.09 ± 23
..	Nitrile Glove	3	4.8 ± 1.8 MPa	4.4 ± 0.1 MPa	0.09 ± 17

Table 1
Summary of experimental results from multiple trials