Physical Design Proposal
Team Point Break - Team 5

Brianna Lossow, Alexander Karampelas, Omar Elmejjati

Activity Report

1 Proposed Solution

The existing components within the tensile tester will be upgraded to allow for a larger maximum load, as well as improved system accuracy and ease of use. In order to increase system ease of use, a touch screen will be implemented to allow the user to interface with the system without requiring extra software to be installed. Upgrading the load cell from a 5kg to 20kg cell, replacing the existing rope with a sturdier vinyl-encased steel cable, and adding a pulley system will help to improve the system's durability and allow for a more uniform application of force. Adding a buzzer to the system to warn the user before the maximum load of the load cell is reached will also allow for greater long-term durability of the system, as the user will likely not continue to add force and damage the system.

2 System Architecture

The current improvements to the tensiometer will be implemented by focusing on its core components. Several points of failure within the system have been upgraded to support a larger maximum load and increasing its range of typical functionality. To make the system more accurate, software will be used to carefully calibrate the system until it is working as expected.

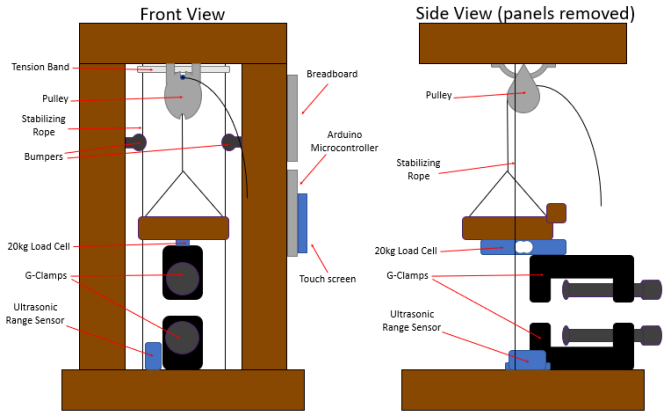

Figure 1. Physical design layout of the upgraded system, including front and side view.

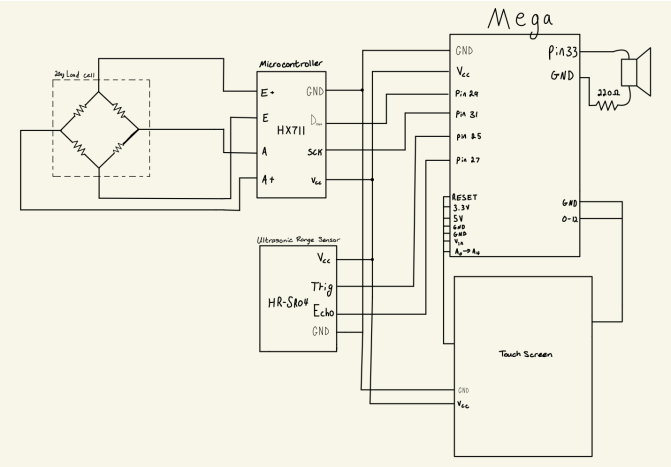

Figure 2. Schematic diagram of tensiometer electronics.

- *Brianna Lossow,*
  E-mail: blossow@albany.edu,
- *Alexander Karampelas,*
  E-mail: akarampelas@albany.edu,
- *Omar Elmejjati,*
  E-mail: oelmejjati@albany.edu,
  University at Albany.

Item	Part #	Cost
Load Cell 20kg	ADA-4543	$4
1" Pulley	N100-308	$4
9/16" Rope Loop	N100-342	$3
3/32"x36" Vinyl-Coated Wire Rope	AC6000B	$2
Piezo Buzzer	ADA-1536	$1
50lb Capacity Fishing Line	SpiderWire	$13
2.8" Touch Screen Shield	EL-SM-004	$16
microSD Card	32GB	$10
Arduino Mega 2560	A000067	$40
TOTAL		**$93**

Table 1
Components used within the upgraded system and the total cost.

2.1 System Components

A table summarizing the parts and budget is shown in Table 1.

2.1.1 Load Cell (20kg)

The larger load cell will allow for the system to apply a larger force to the material being tested, allowing for a larger testing pool of materials. A 20kg load cell was used instead of other options because it had the best balance between cost and performance.

2.1.2 1" Pulley & 9/16" Rope Loop

Both the pulley and its mounting hardware allow for a more consistent application of force to the material being tested, as well as a smoother user experience. These options were chosen due to their load capacity and relatively small size, allowing for the system to still retain its maximum height while further increasing the durability of the system.

2.1.3 3/32"x36" Vinyl-Coated Wire Rope

The vinyl-coated rope will last longer compared to its original rope counterpart, and allows for a more uniform application of force as the wire rope will move better within the pulley. The vinyl wire has a larger maximum force and better grip than other alternative options.

2.1.4 Piezo Buzzer

The buzzer is exclusively used within the alternate error flow of the system, which will discourage the user from continuing to apply

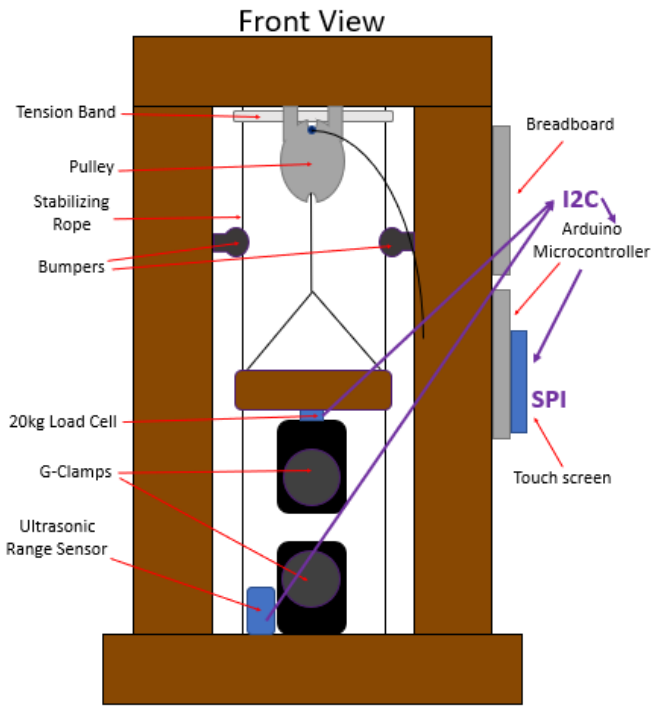

Figure 3. The tensiometer system implements two communication standards (protocol) I2C and SPI.

force beyond the system's maximum load. A buzzer is both efficient and effective at grabbing the user's attention in order to discourage them from continuing, as further use could potentially damage the system.

2.1.5 2.8" Touch Screen

Adding a touch screen interface to the system allows for a smooth user experience, allowing for use of the system without requiring a computer connection or installation of Arduino software. The touch screen module contains a built in SD card module, which solved multiple issues regarding software dependency and was the best cost-effective solution.

2.1.6 Arduino Mega 2560

Due to the touch screen module and greater memory requirements, the Arduino Uno R3 was upgraded to an Arduino Mega 2560 to allow for extra peripheral ports and a larger operating memory to support the system.

2.2 Engineering Standards

The tensile tester has two basic communications standards, using both I2C and UART pro-

tocols in order to effectively interface between components and the users PC.

2.2.1 I2C Protocol

The I2C protocol is used to make accurate recordings of information from the load cell, distance sensor, touch screen, and the Arduino Mega. Because of this protocol allowing for one master connecting to several components, the Arduino is used to interface with each component present within the tensiometer using I2C protocols.

2.2.2 UART Protocol

The UART protocol is not used in this system, since the current state does not require a computer connection.

2.2.3 SPI Protocol

The SPI protocol is used to export data to the SD card embedded in the touch screen

2.2.4 Data Standards

The data from the tensiometer is exported as a CSV file which can then be studied for further data analysis using programs such as Microsoft Excel or MATLAB.