Physical Design Proposal
The Salty Sea Dogs Team #11

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Activity Report

1 Proposed Solution

Various steps will be taken to improve the system's precision and ease of use. To improve the existing system, a step motor will replace the ultrasonic range sensor in order to improve the accuracy of the distance and control the speed of the stretch in the material. The motor will be turned into a known and controlled amount of degrees at a time and this data calculate the change in distance of the rope. To further accommodate this, the rope will be replaces with a thinner string so layering does not compromise the accuracy as much. The load cell will be replaces with a 20 kg cell so stronger materials can be tested and so readings will be more accurate when the material is about to break. An LCD and buttons will be installed for ease of use. The buttons will control the motor and calibration process and the LCD will display instructions as this takes place. Finally, wing nuts will be added to the given clamps to secure the material more easily without drastically increasing cost.

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2 System Architecture

To start, a main problem with the original system was not having the force be a consistent factor. The new system will have the stepper motor moving at a set speed. The motor will be mounted on the bottom of the system. The string will wrapped around the motor and attached to a pulley system. When the switch is pressed on the top, the motor will move up in a set speed. When it is pressed on the bottom, the motor will move down. This results in a controlled and adjustable data collection system. In addition, we also had issues securing the material within the clamps. The clamps will have wing nuts in order to alleviate this issue while keeping costs low. Also, the LCD will be mounted to the front of the system on the top and will display instructions from the embedded system. Buttons for calibration will be on the breadboard and the driver with the switch will be mounted on the side of the system below the breadboard.

2.1 System Components

2.1.1 Load Cell (20kg) / HX711 Amplifier

The new system utilizes a 20 kg load cell. This higher threshold will allow the user to test stronger materials and there will be greater accuracy when materials get closer to breaking.

2.1.2 Stepper Motor

The new system requires use of a stepper motor that is used in order to pull the tensile tester device. This is what will be used to control the stretching of the substance.

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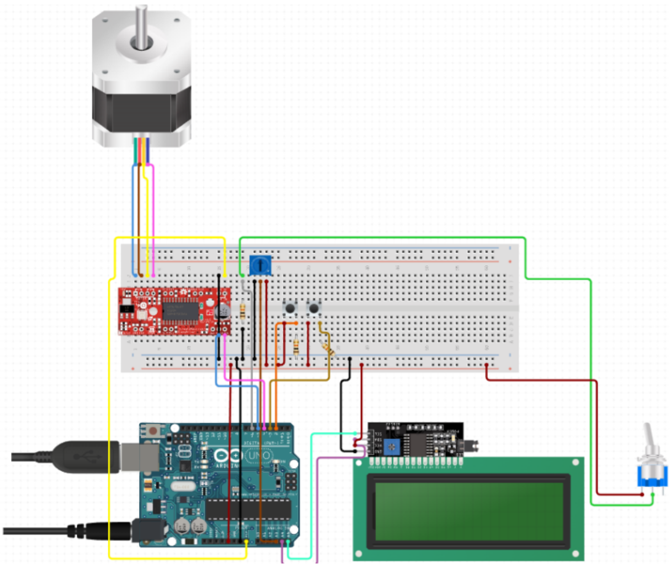

Figure 1. Wiring diagram of tensiometer electronics.

Part	Cost	Notes
Stepper Motor	$23.99	24-48V; 2.8A Motor -- Measures Distance
Motor Power Supply	$16.79	Output: 24V, 4A -> 96W -- Provides necessary power
Motor Controller	$10.99	9-42V; Model TB6600 -- Controls System
20 kg Load Cell with Amplifier Board	$9.49	20 kg -- Measures Force
LCD/(I2C protocol controller)	$12.99	20x4 -- Displays Instructions
Switch	$8.99	3 way momentary switch
String	$2.99	Thinner string for system
Wing Nuts	$5.99	8 Wing Nuts to reinforce the clamps.
Total Cost:	$83.24	
Max Budget:	$150.00	
Budget Remaining:	$66.76	

Figure 2. Budget of new system.

2.1.3 New String

The new system will have a different string to be pulled. This string is thinner, allowing for more minute measurements to be taken for improved accuracy.

2.1.4 Buttons

The improved system has a switch for controlling the motor. Rather than using a toggle, the motor will turn until the user lets go of the switch. Also, the modifies system has buttons in the breadboard used to trigger instructions for calibration and testing.

2.1.5 LCD

The LCD displays data and instructions so the user won't have to look at the console in Arduino at all times.

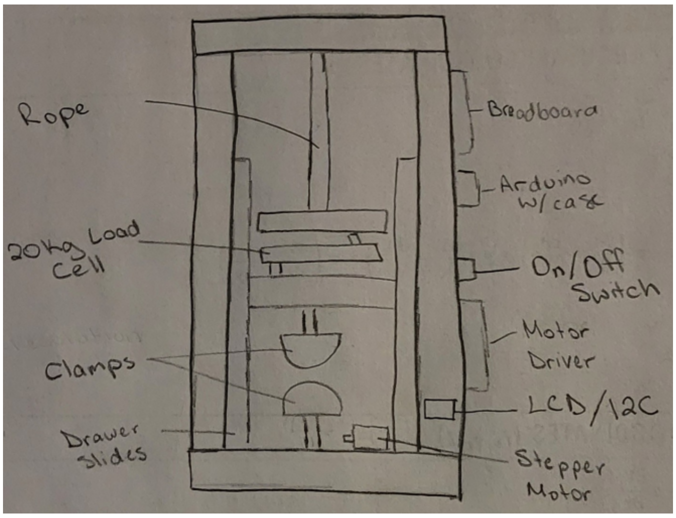

Figure 3. The new tensiometer system implements a stepper motor, 20 kg sensor, switch, wing nuts, thinner string, and LCD.

2.2 Engineering Standards

The modified system will use the I2C and UART protocols.

2.2.1 I2C Protocol

The system will be using the I2C protocol to record measurements between the load cell and the Arduino Uno. The LCD will also be using this method to communicate with the Arduino. This protocol can support multiple controls and peripherals with just two wires. The first controller to pull SDA low wins control. The address sequence is then analyzed and the instruction to record data and communicate is made. When this is acknowledged by the NACK/ACK bit, the first 8 bits are sent and data is transmitted until the receiver stops getting data or a stop condition is met.

2.2.2 UART Protocol

The connection between the laptop/embedded system and the Arduino Uno will utilize the UART protocol. It does not require a clock signal, but it requires communication purely between two devices (two lines support two way communication) and our embedded system will have a BAUD rate established ahead of time. When the code is compiled data will be recorded. An important thing to know is that there is no control of when data is sent and there is no guarantee that both sides are running at exactly the same rate.

2.2.3 Data Standards

The data will will be recorded in an Arduino Spreadsheet and can be exported either to Matlab or Excel as a .csv file.

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