# Physical Design Proposal Number #9

Zhen Xu, Liuhuan Zhang, Gavin Haar

*Activity Report*

## 1 Proposed Solution

In the initial design there are multiple flawed aspects. Broadly speaking, these are components which prevent the user from consistently applying force to the material. A few examples are that the rope needs to be pulled by hand, and that there is a large amount of friction in the ring on top of the system. In summary, most of the improvement to the system will come from optimizing the method of applying force to the material. Thus,the experiment will be improved in three ways – Improving System accuracy, Ease of use and Reduced setup time. In terms of system accuracy, improving code to reduce noisy by acquiring average value, installing servo motor to reduce artificial error and changing stronger clamp to catch materials tightly. In terms of ease of use, Blynk could be used to control the motor rotating or rolling back even its speed which could collect more data. About reduced setup time, Arduino code could be used when calibrating the material. Also, Matlab could easily gets graph and its values of Young's modulus and Ultimate tensile strength.


- *Zhen Xu,*
  *E-mail: zxu7@albany.edu,*
- *Liuhuan Zhang,*
  *E-mail: lzhang21@albany.edu,*
- *Gavin Haar,*
  *E-mail: ghaar@albany.edu,*
  *University at Albany.*


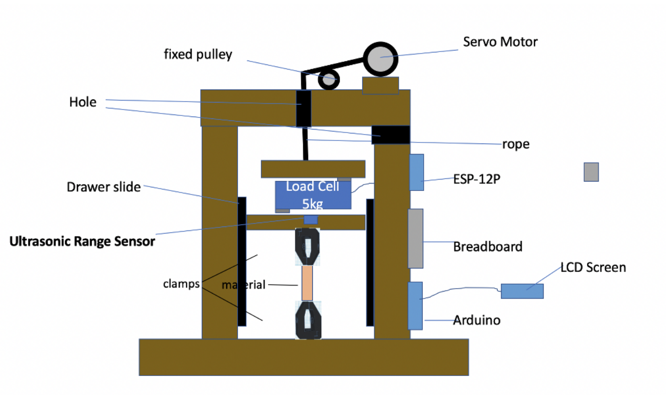


Figure 1. Current state of the tensiometer physical design

## 2 System Architecture

First install a Servo motor, and fixed at the top of the machine. By doing this, slowly pulling the string reduces the perceived error so that the collected data is not too cluttered. Second,a pulley is installed at the top to reduce friction and improve the accuracy of data collection. Third, replace the rope with cable pulled by motor so that it stays stiff all the time. Reduce the impact of the rope's elasticity. Fourth, improve the clarity of the stress-strain curve is to improve the code to reduce noisy by taking average values. Also, Matlab could help produce perfect graph, value of Young's Modulus and value of Ultimate tensile Strength. Fifth, WIFI module could control servo motor with smartphone's application—Blynk. It is interesting. sixth, stronger clamp printed by 3D printer.

Figure 2 depicts the current system circuitry with the load cell acting a wheatstone bridge

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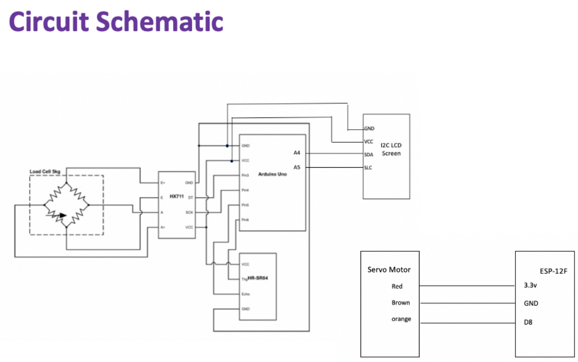


Figure 2. Schematic diagram of tensiometer electronics.

and the resulting output voltage amplified to the range of the ADC. The HX711 board and LCD Screen uses the amplifed value to perform a ADC conversion and then communicates the results using the I2C communication standard with the attached microcontroller. In the WIFI module, it is separate from the above system. ESP-12F connects to the motor's signal, and Blynk could control the signal as to let motor rotate or rollback.

In terms of HX711, GND – GND(Arduino), VCC – VCC(Arduino), DT – Pin2(Arduino), SCK – Pin3(Arduino).

In terms of LCD Screen, GND – GND(Arduino), VCC – VCC(Arduino), SDA – A4(Arduino), SLC – A5(Arduino).

In terms of HR-SR04, GND – GND(Arduino), VCC – VCC(Arduino), Echo – Pin4(Arduino), Trig – Pin5(Arduino).

In terms of ESP-12F, 3.3v – Red wire(Servo Motor), GND – Brown wire(Servo Motor), D8 – Orange wire(Servo Motor).

## 2.1 System Components

First, the installation of the servo motor avoids the error caused by pulling the rope manually. Because the motor can pull the rope at a constant speed and the speed of the motor can be controlled by Blynk so that more data can be obtained to ensure accuracy.

Second, we use a 3D printer to print the clamp which is stronger than original one so that could reduce error

| Item | Part # | Cost |
|---|---|---|
| Rope | Cable | $9 |
| LCD Screen | I2C | $5.5 |
| WIFI module | ESP-12P | $9 |
| Servo Motor | 30kg | $24 |
| Others | Fixed pully and screw | $5.5 |
| **TOTAL** | | **$53.5** |

Table 1
overview cost of new parts

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

### 2.1.1 *Load Cell (5kg) / HX711 Amplifier*

Load Cell could be used to measure the force exerting on the material.

### 2.1.2 *Ultrasonic Range Sensor*

And Ultrasonic Range Sensor could measure the distance between Sensor and the bottom

### 2.1.3 *Rope*

Reduce the impact of the rope's elasticity.

### 2.1.4 *Graphical Display*

The current system uses the serial monitor to collect the data. If this changes, document the new methodology.

### 2.1.5 *Laptop w/ Arduino Software*

The current system requires use of a computer running the Arduino IDE to collect data from the serial monitor.

### 2.1.6 *LCD Screen*

Allows customers to see changes in visual data

### 2.1.7 *Servo Motor*

Avoid the error caused by pulling the rope manually.

### 2.1.8 *ESP-12F*

Control servo motor's speed and its direction of rotation.

## 2.2 Engineering Standards

In the current system, there are two communication standards (protocols) that are utilized: I2C and UART, as shown in figure 3. Briefly describe how these work.

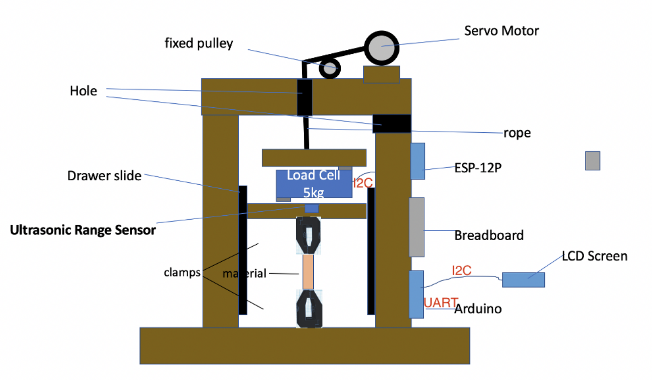


Figure 3. The current tensiometer system implements two communication standards (protocol) I2C and UART.

### 2.2.1 I2C Protocol

Inter-Integrated Circuit (pronounced eye-squared-C). It can supports multiple controllers and multiple peripherals

### 2.2.2 UART Protocol

A hardware communication protocol that uses asynchronous serial communication with configurable speed.

### 2.2.3 Data Standards

When getting data from Arduino monitor window, copy that and save it in an Excel file. Then, using Matlab, which is specifically designed, to get graph of Young's Modulus.