

Deformation-Measuring Automation System

Prototype and Expandable Construction

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Course Project GEOSC 597-3

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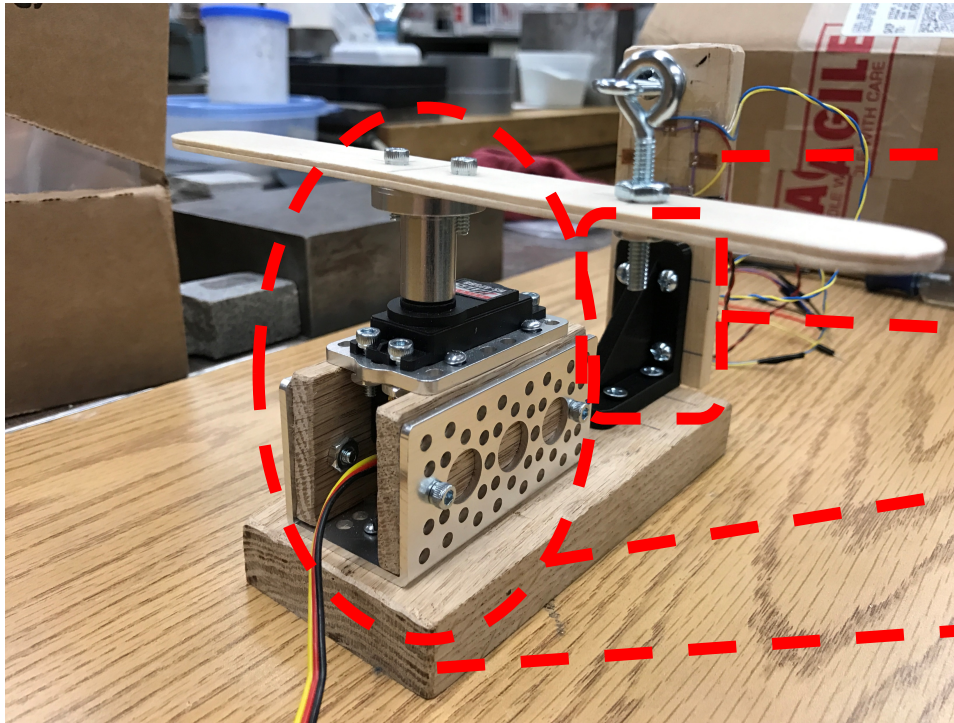
Motivation & Objectives

- In most cases, experiment operators need to keep a close eye on the ongoing experiment, which makes people feeling bored.
- Build a semi/full-automatic experimental system will help improving experimentation environment and experiences.
- Automatic systems feature pre-set shutdown criteria which, in some cases, are safer than manually operated systems.

Apparatus Components

- Hardware
 - Load frame.
 - Servo motor with a wooden arm.
 - Arduino boards (servo controller and data acquisition system).
 - Wooden bar for deformation measurements.
 - Full-bridge strain gage circuit.
- Software
 - Data acquisition/servo motor control program (one_channel_serial_reader.vi)

Hardware: Load Frame



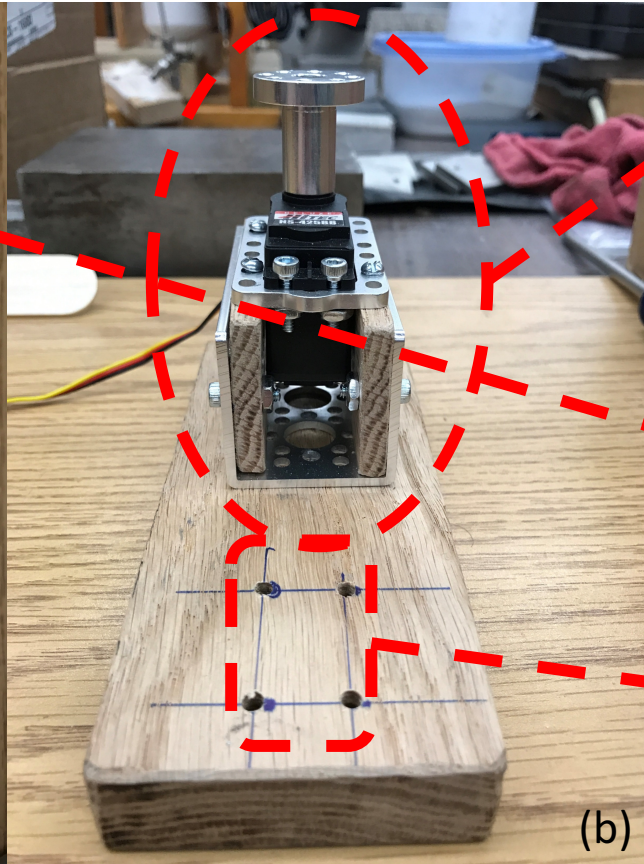
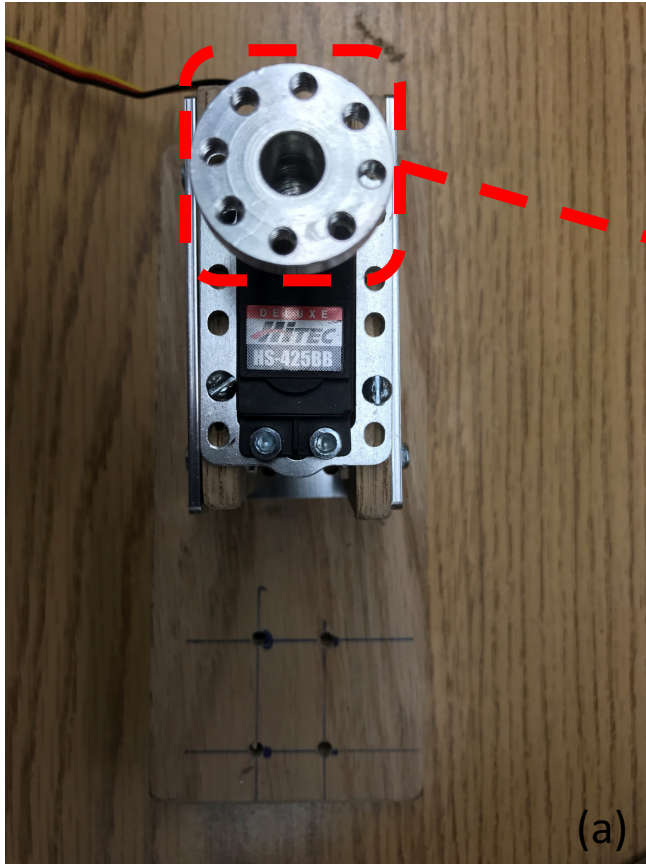
Wooden bar
Full-bridge strain
gages configuration

3-D Printed bar holder

Servo motor and
wooden arm

Wooden platform

Hardware: Servo Motor

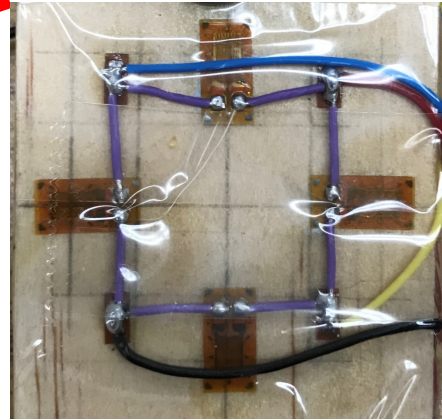
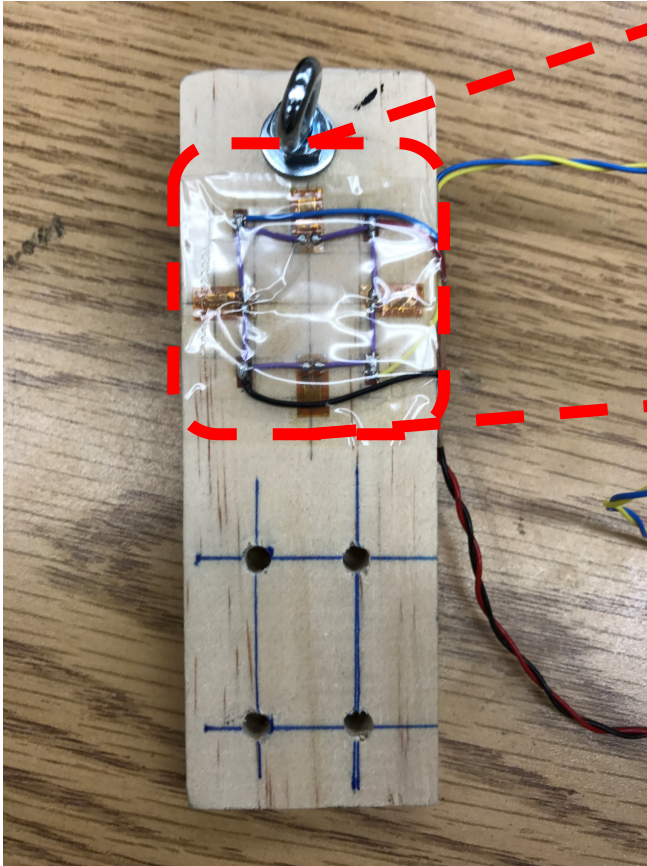


Servo motor is mounted in an aluminum bracket

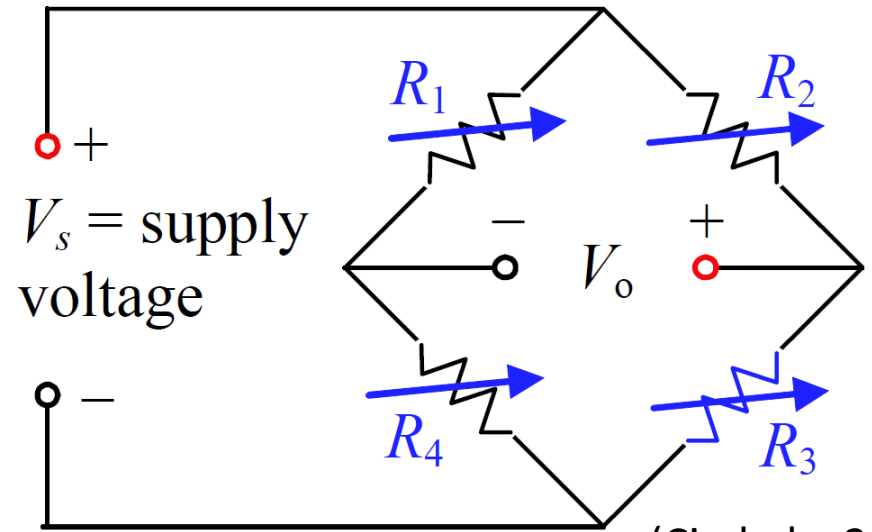
Wooden arm is mounted here

3-D Printed bar holder is mounted here

Hardware: Wooden Bar

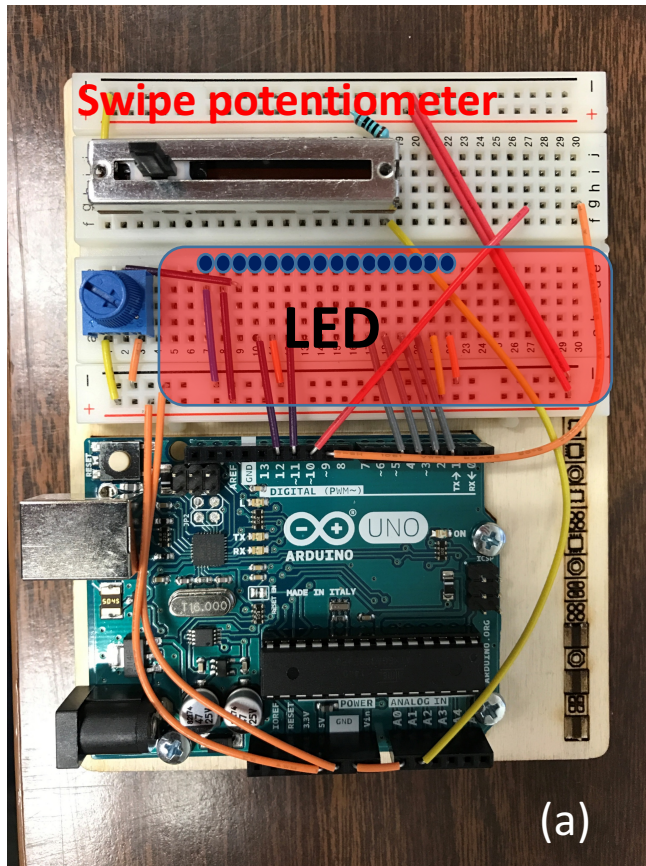


Full-bridge configuration

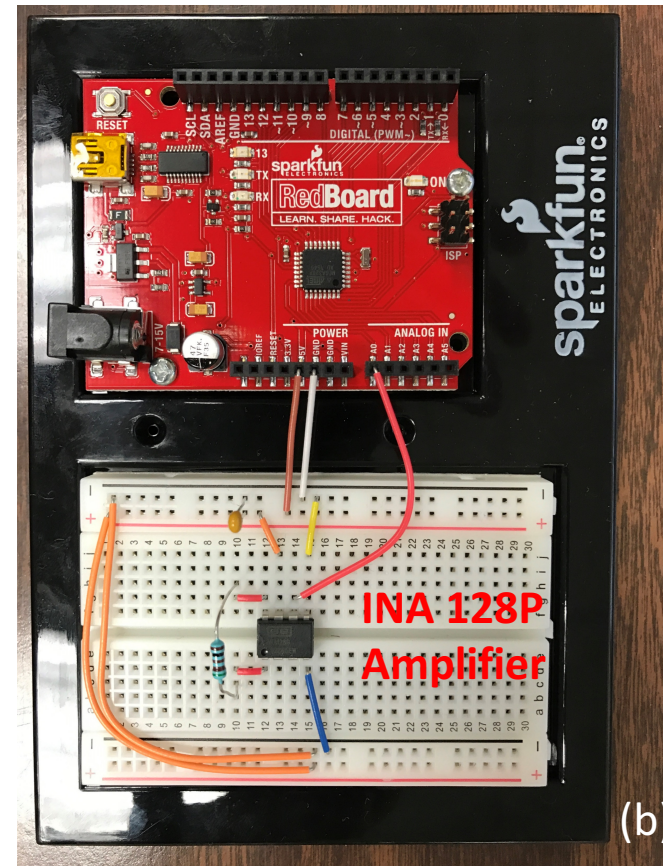


(Cimbala, 2013)

Hardware: Arduino Boards

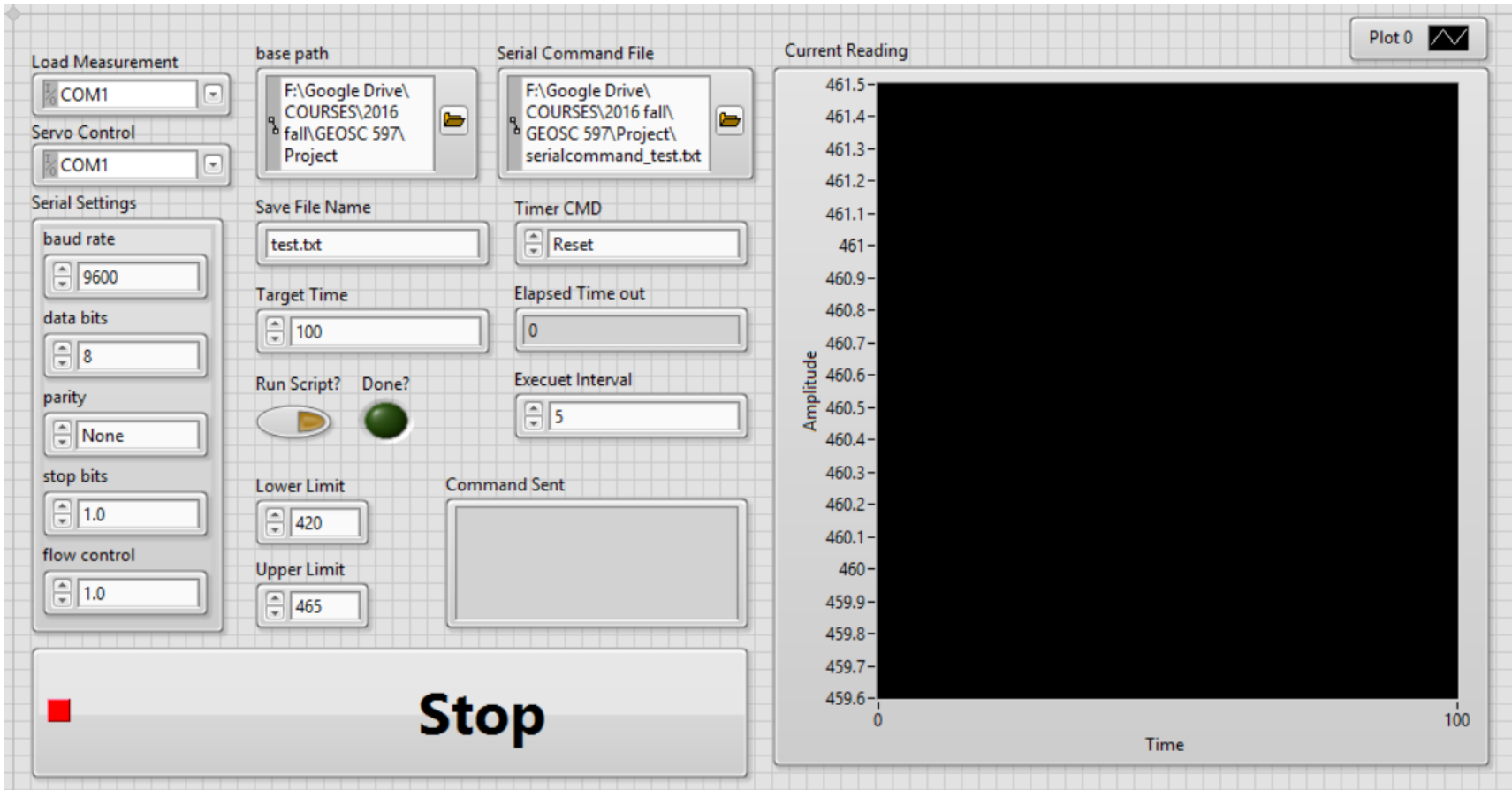


AB1: Servo Motor Controller



AB2: Signal Amplifier and data logger

Software: Serial Control Panel Data Logger



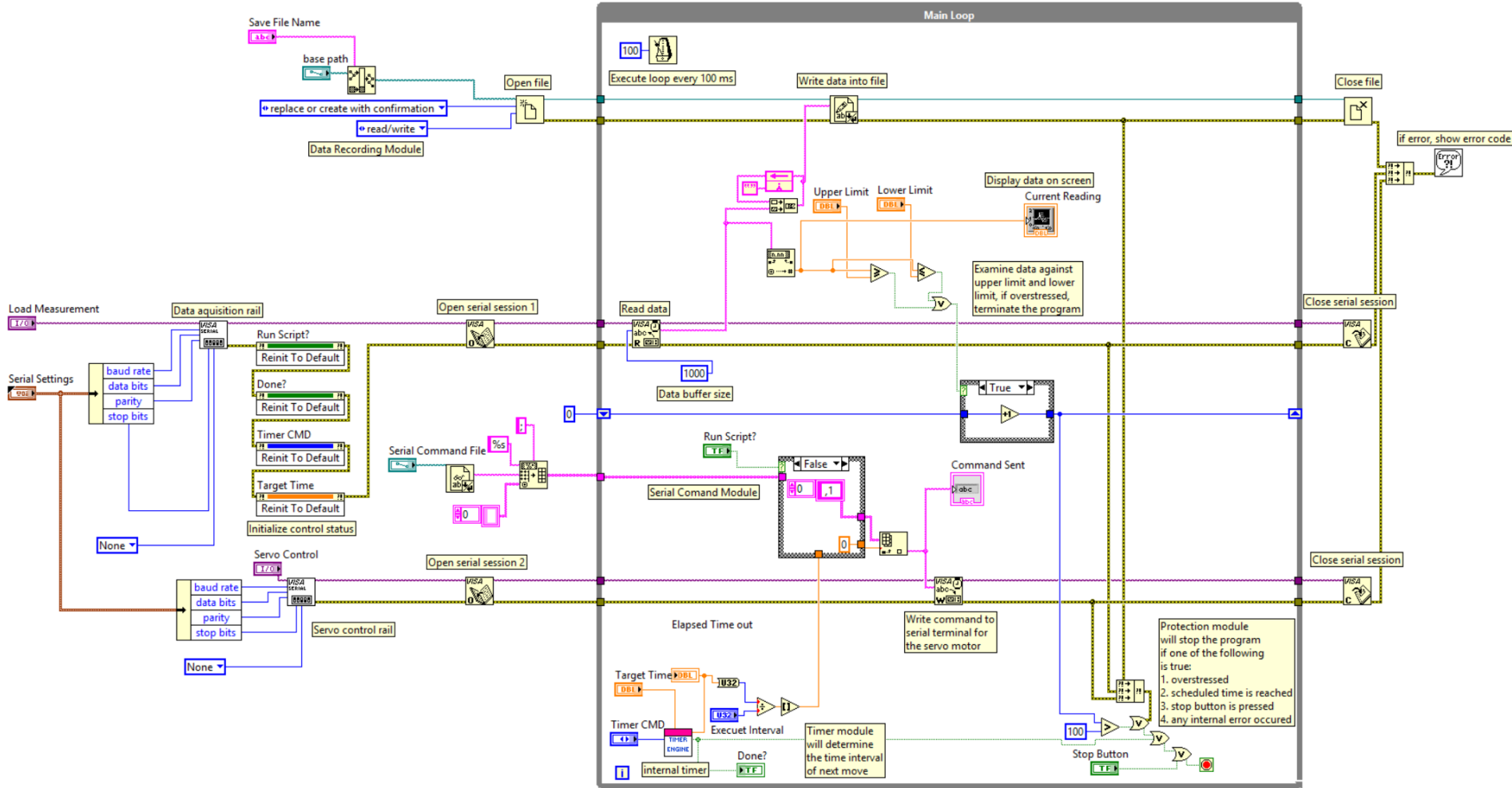
The screenshot displays the Serial Control Panel Data Logger software interface, which is organized into several functional sections:

- Load Measurement:** A dropdown menu currently set to "COM1".
- Servo Control:** A dropdown menu currently set to "COM1".
- Serial Settings:** A vertical stack of controls including:
 - baud rate:** A numeric input field set to 9600.
 - data bits:** A numeric input field set to 8.
 - parity:** A dropdown menu set to "None".
 - stop bits:** A numeric input field set to 1.0.
 - flow control:** A numeric input field set to 1.0.
- base path:** A file browser showing the path "F:\Google Drive\COURSES\2016 fall\GEOSC 597\Project".
- Serial Command File:** A file browser showing the path "F:\Google Drive\COURSES\2016 fall\GEOSC 597\Project\serialcommand_test.txt".
- Save File Name:** A text input field containing "test.txt".
- Target Time:** A numeric input field set to 100.
- Run Script? / Done?:** Two radio buttons, with "Done?" selected.
- Lower Limit:** A numeric input field set to 420.
- Upper Limit:** A numeric input field set to 465.
- Timer CMD:** A dropdown menu set to "Reset".
- Elapsed Time out:** A numeric input field set to 0.
- Execuet Interval:** A numeric input field set to 5.
- Command Sent:** A large empty text area for displaying sent commands.

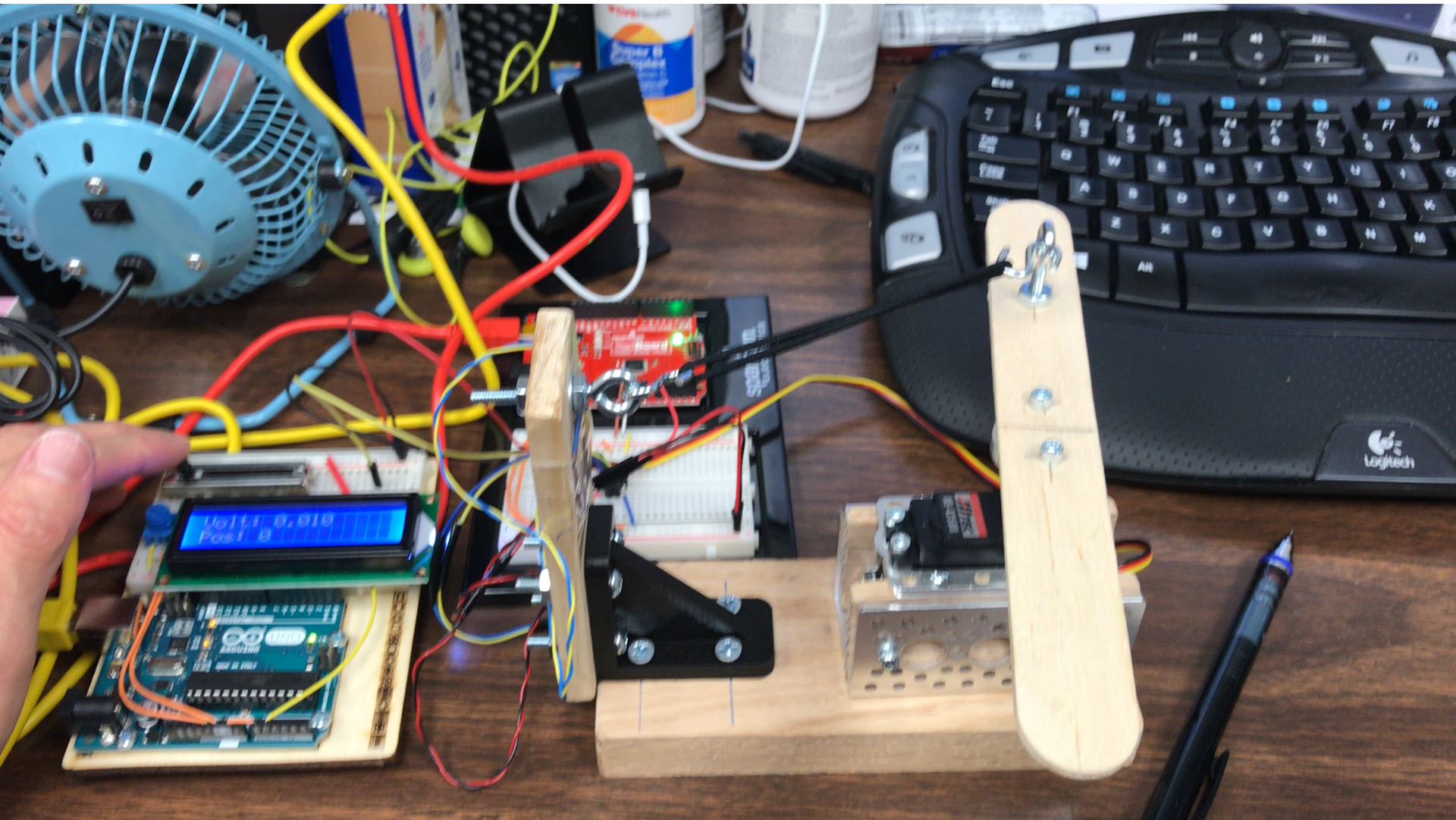
At the bottom left, there is a prominent red square icon and a large "Stop" button.

On the right side, the **Current Reading** section features a plot titled "Plot 0". The y-axis is labeled "Amplitude" and ranges from 459.6 to 461.5. The x-axis is labeled "Time" and ranges from 0 to 100. The plot area is currently black, indicating no data has been recorded.

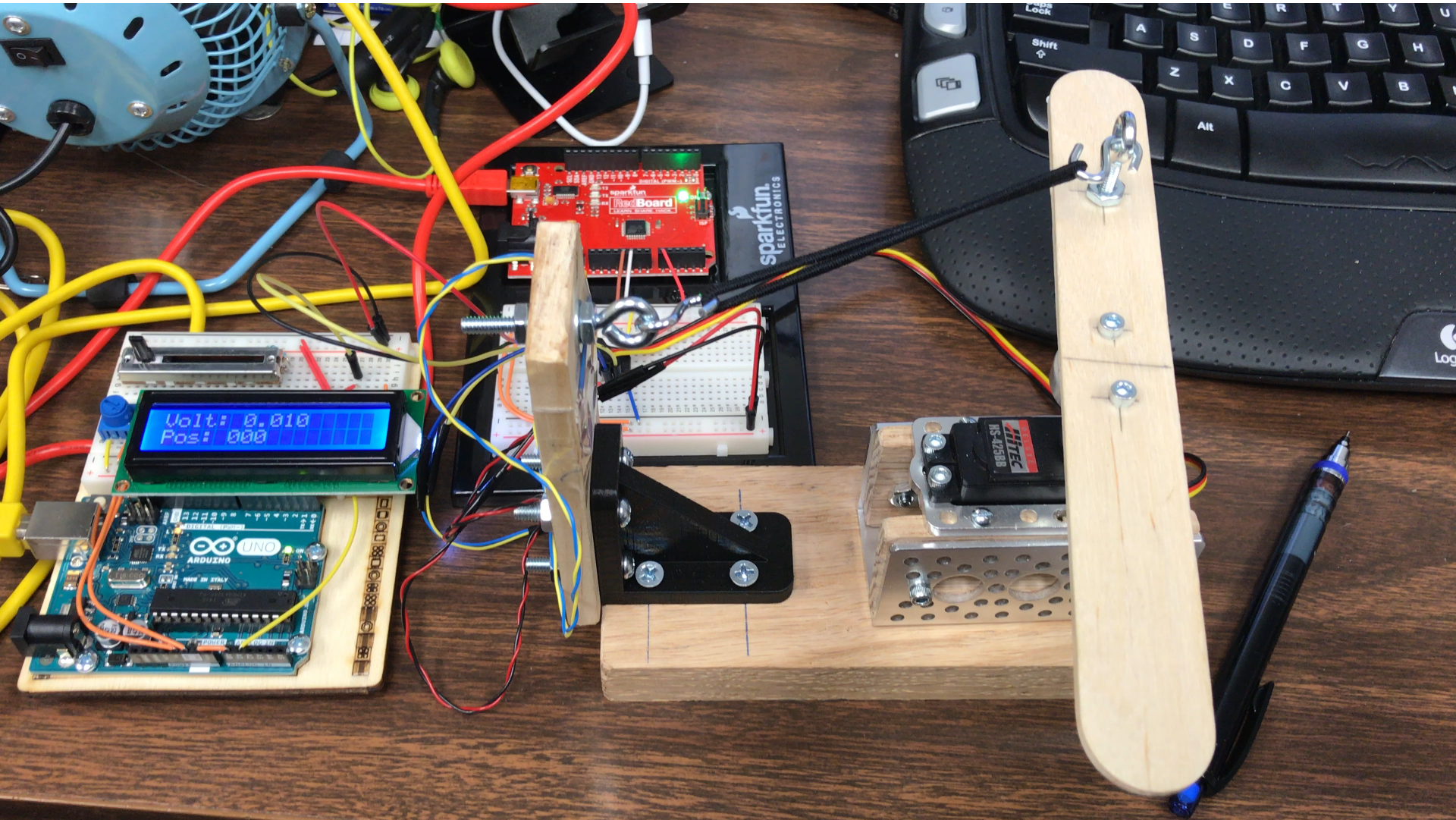
Software: Serial Control Panel Data Logger



Experimental Performance: Manual Mode



Experimental Performance: Automatic Mode



Experimental Performance: Automatic Shutdown

The program can automatically shutdown by itself according the following criteria:

1. If the deformation is too large.
2. If the scheduled time is exhausted.
3. If the stop button is pressed.
4. If there is a internal program error.

Limitations and Expandability

- Limitations:
 - A lot...
 - Can only measure deformation of bars with one degree of freedom, etc....
- Expandability:
 - Some...
 - Data acquisition and control program can be expanded to accommodate more complicated applications.

Acknowledgement

Hereby I want to express my sincere acknowledgements to Dr. Chris Marone and course instructor Dr. John Leeman for their patient instructions and inspiring lectures.

And thank you to all kind friends and people in the rock mechanics lab who tolerated me for doing wood work and making mess around.