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Deformation-Measuring Automation System

Prototype and Expandable Construction

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Course Project GEOSC 597-3

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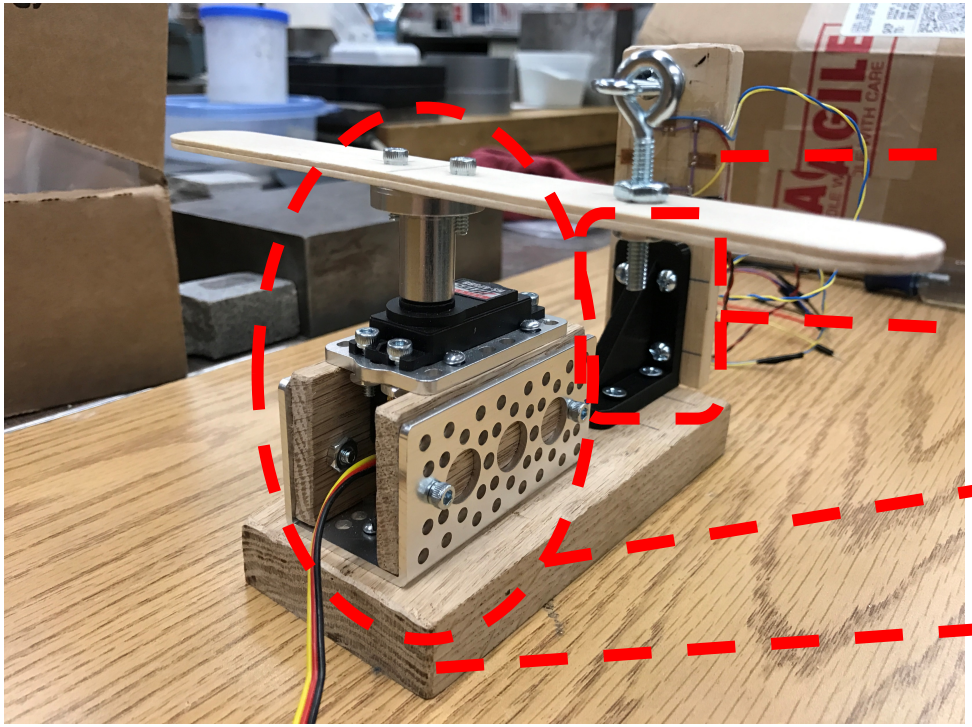
Motivation & Objectives

- 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



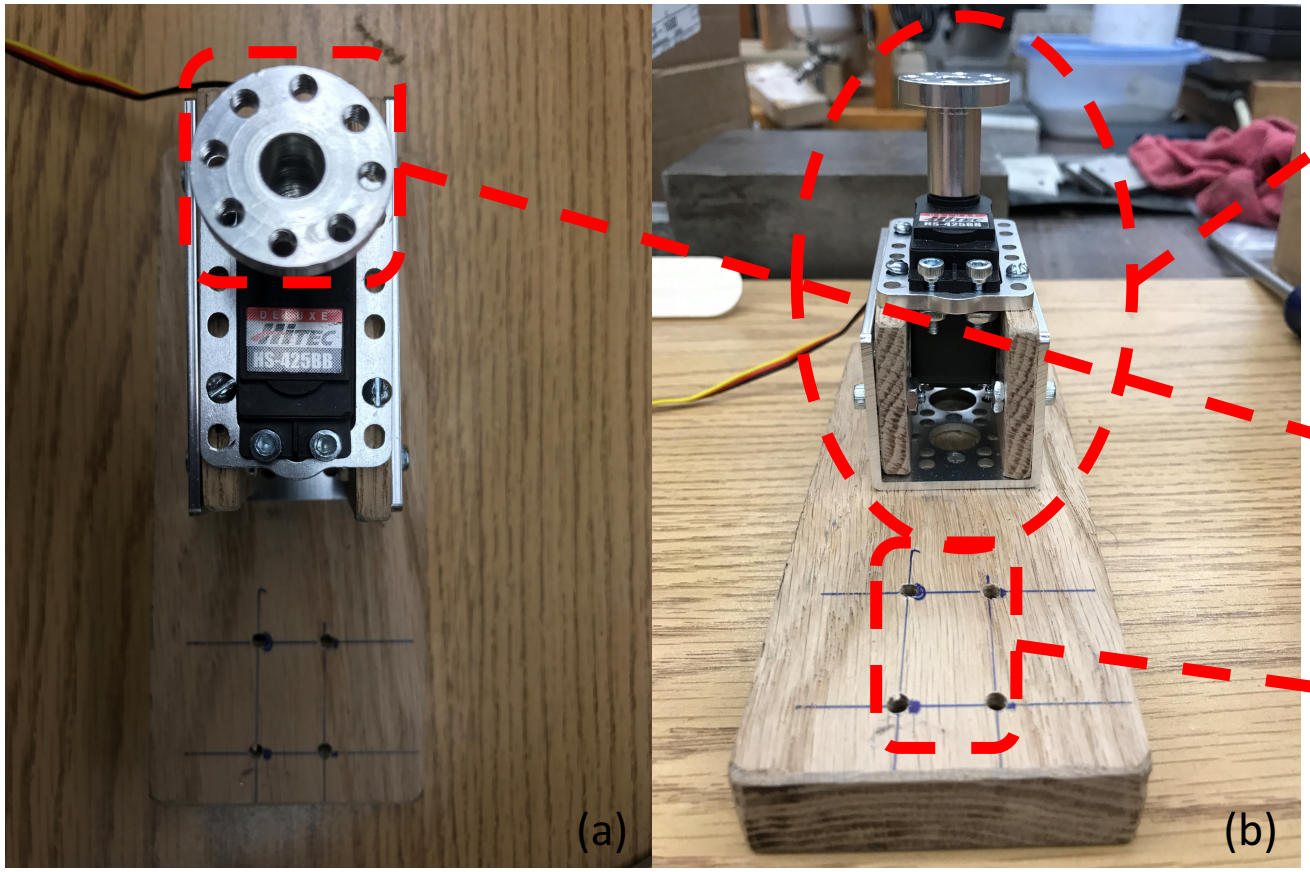
Wooden bar
Full-bridge strain gages configuration

3-D Printed bar holder

Servo motor and wooden arm

Wooden platform

Hardware: Servo Motor

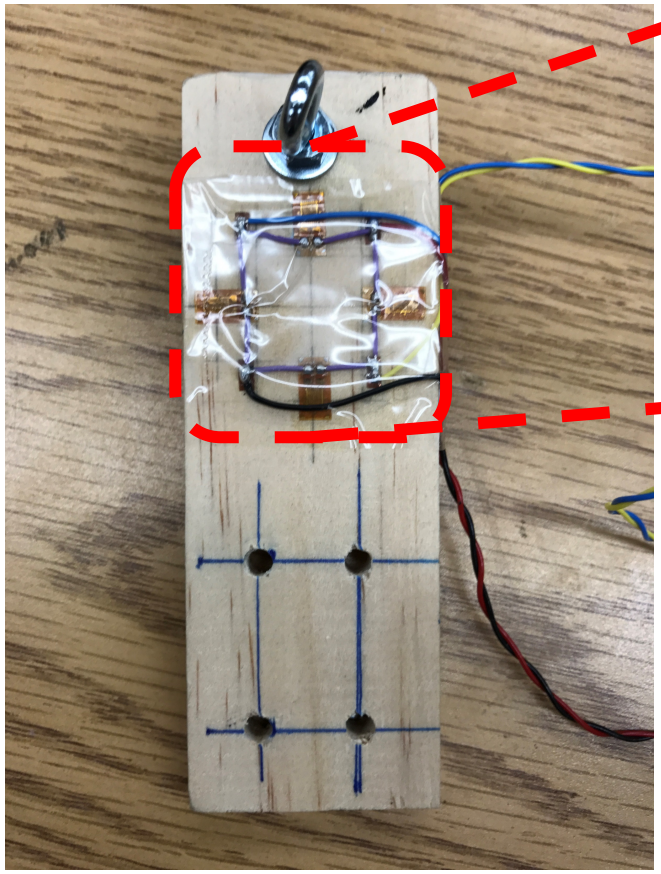


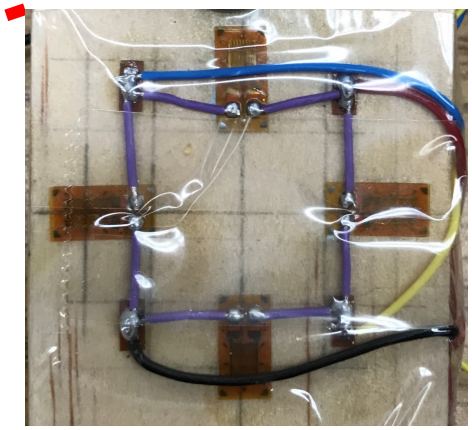
Servo motor is mounted in an aluminum bracket

Wooden arm is mounted here

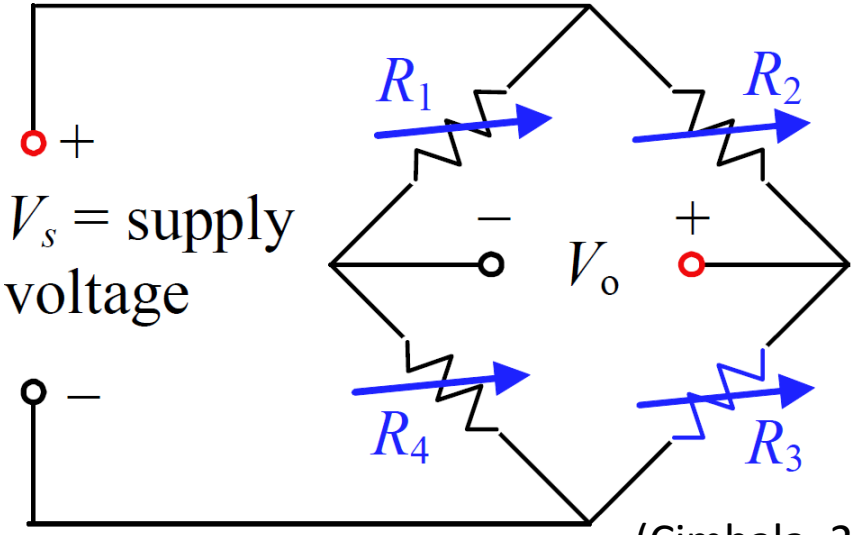
3-D Printed bar holder Is mounted here

Hardware: Wooden Bar



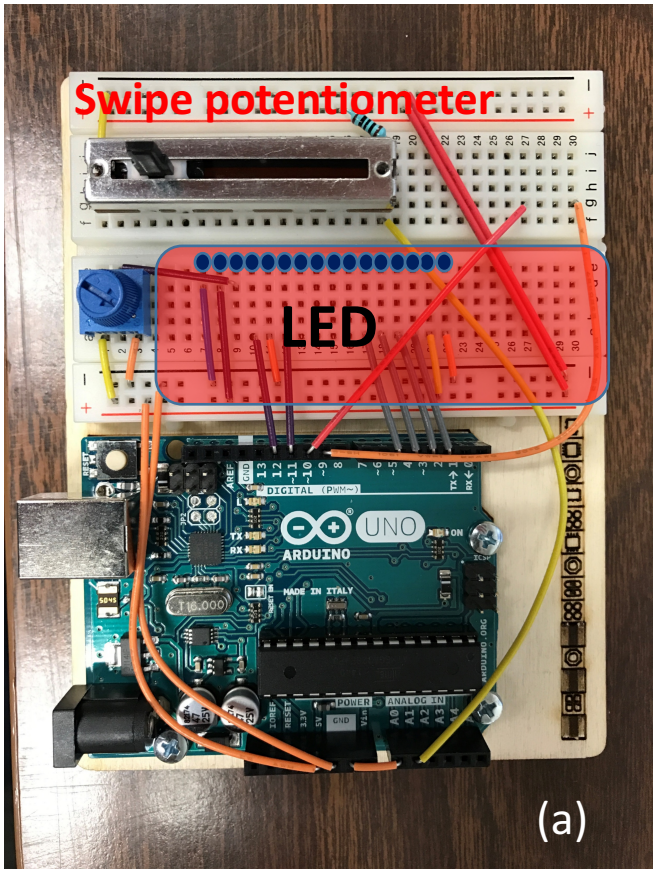


Full-bridge configuration

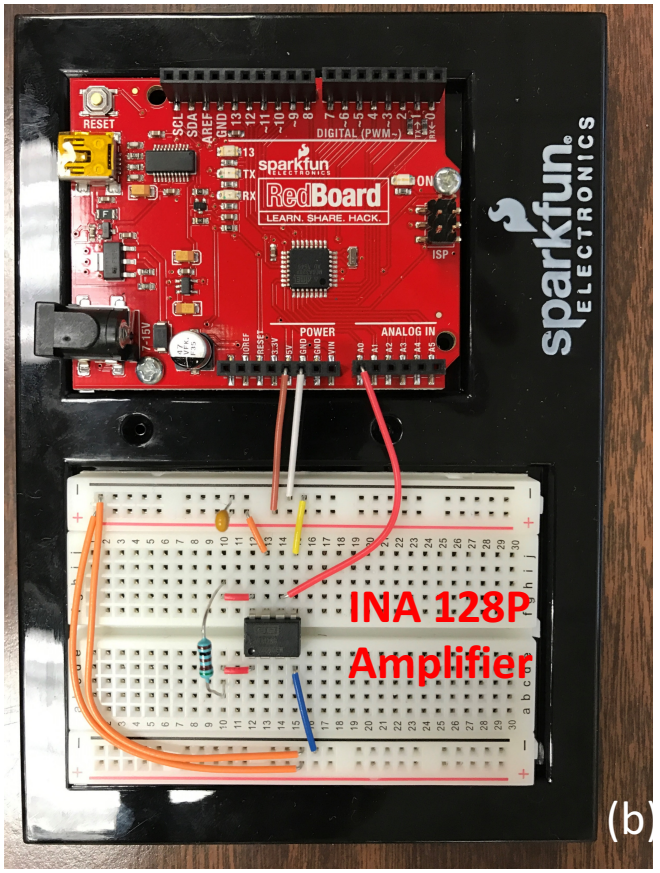


(Cimbala, 2013)

Hardware: Arduino Boards

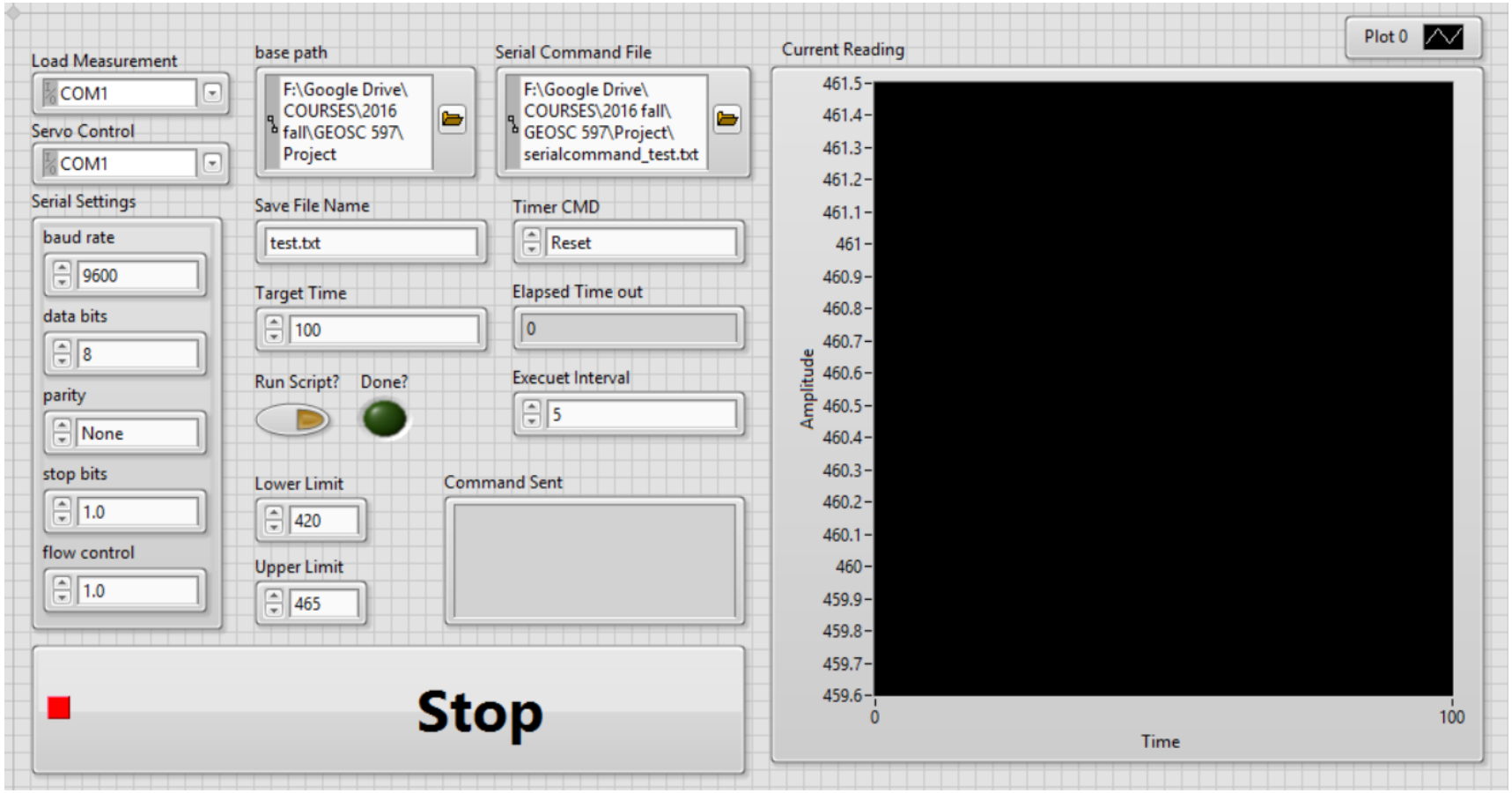


AB1: Servo Motor Controller

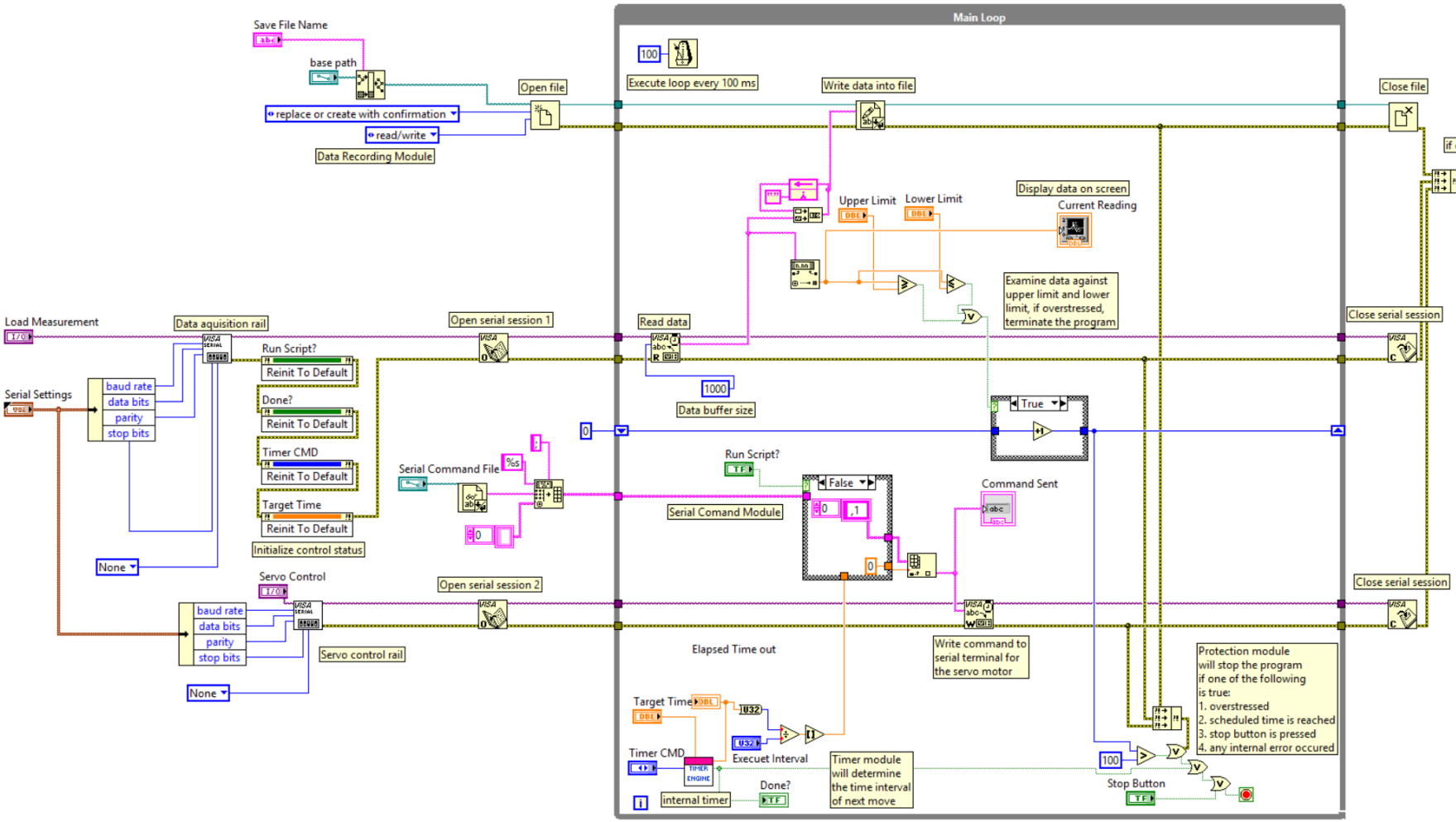


AB2: Signal Amplifier and data logger

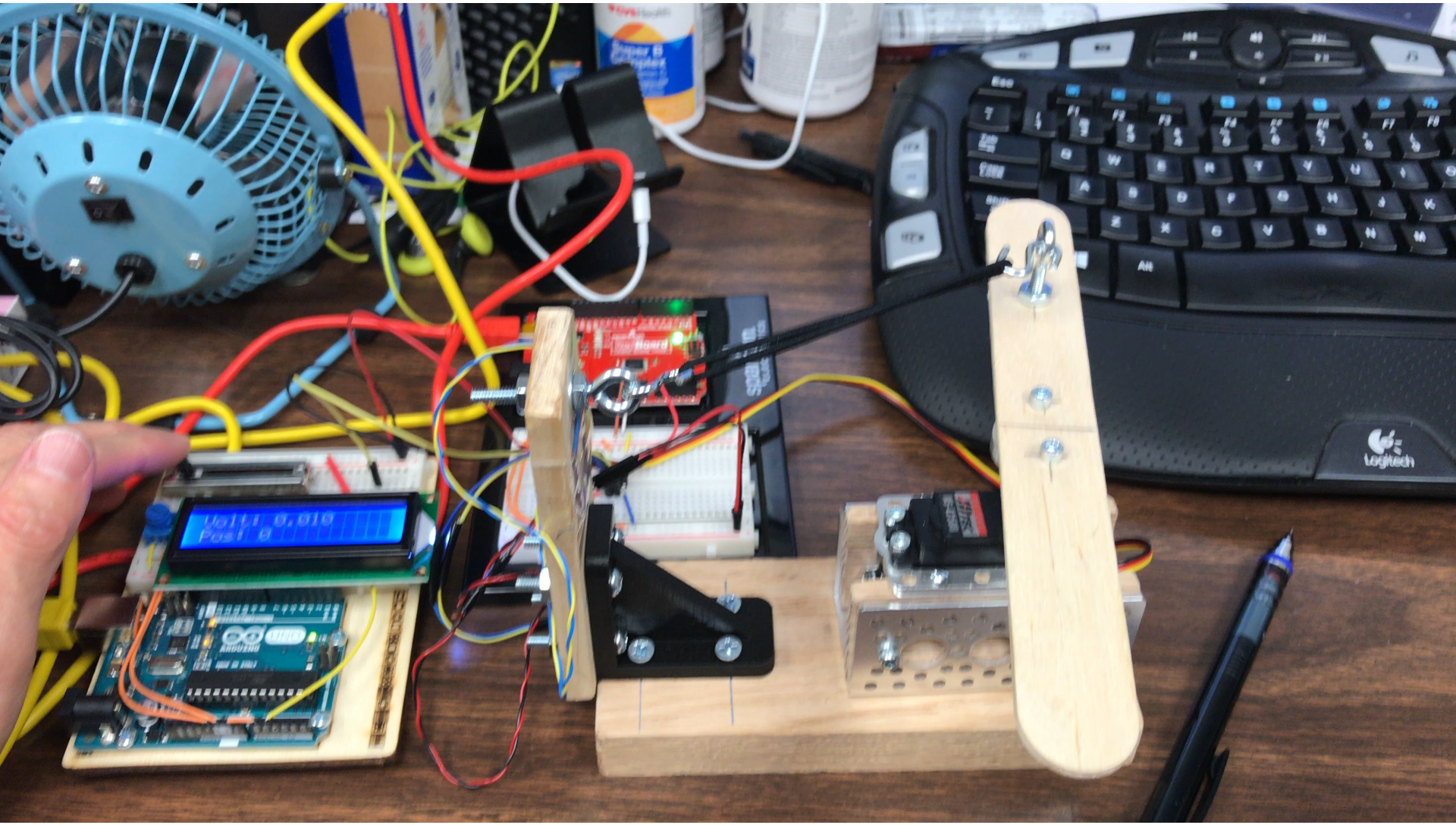
Software: Serial Control Panel Data Logger



Software: Serial Control Panel Data Logger



Experimental Performance: Manual Mode



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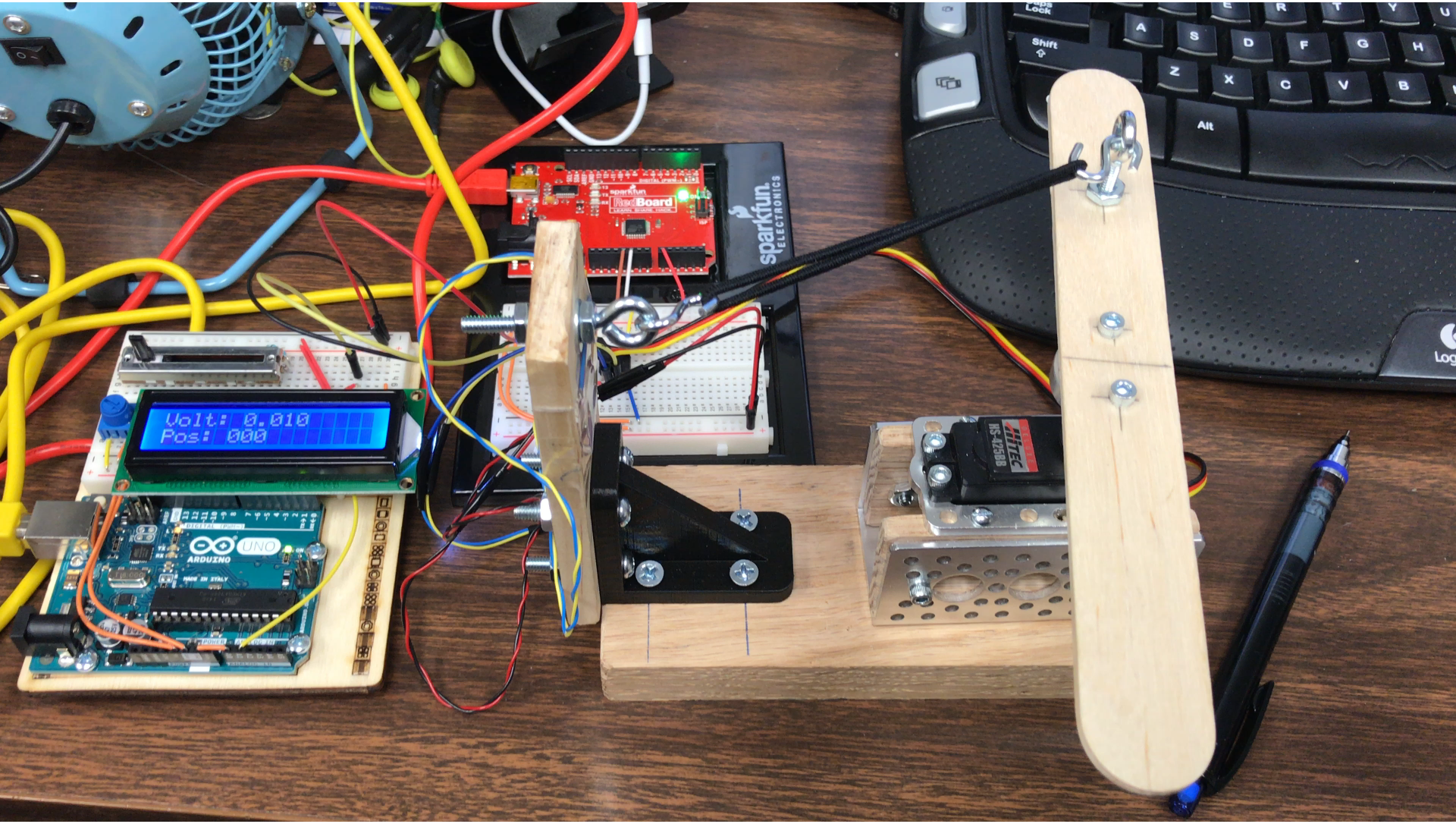
Experimental Performance: Automatic Mode



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.