Logical Design Proposal MileStone2

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Activity Report

Abstract—The group has identified several issues with the current potentiometer device and proposes to introduce new hardware (a clamp, winch and step motor system) to improve the accuracy of the collected data and help streamline the data collection process. New software will also be introduced to help manage the new hardware system.

Index Terms—Uniaxial Tensiometer, System Analysis, Engineering Design

1 Background

Horizontal movement from the load cell can introduce noise that adversely affects the accuracy of collected data; the potentiometer clamp is unable to completely hold down the material which can cut data collection short, and the load cell is easily affected by external forces that can influence data readings. The goal of this milestone is find solutions for these problems.

As a group we believe that the focus of the project should be on improving ease-of-use while maintaining the accuracy of the collected data, which were the two key concepts that the project sponsors kept repeating during the in-class interview. Therefore, we believe that designing solutions for them should be our priority.

The group proposes using clamps that are better able to hold down the material, along with a winch and step-motor system to help restrict horizontal movement, improving the accuracy of the collected data and helping to streamline the data collection process. New Software will also be steadily introduced to help manage the proposed new parts.

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2 System Requirements & Constraints

See Figure 1 for system requirements and usage/flow plan.

2.1 Requirement #1 Clamp/Winch/Stepmotor System

The chemist/chemistry student should be able to run the the potentiometer's tensile test function with minimum hassle. The expectation is that the device should be able to reliably run tests on the input material and report back accurate data.
For now, the student just needs a laptop and the target material to operate the device. Once the laptop is connected, the interface should take over and the student just needs to follow the prompts on their screen to proceed with the experiment.

Normal Flow
The "happy path".

- **Step #1:** The chemistry student performs calibration and preliminary setup (connect a laptop to the device).

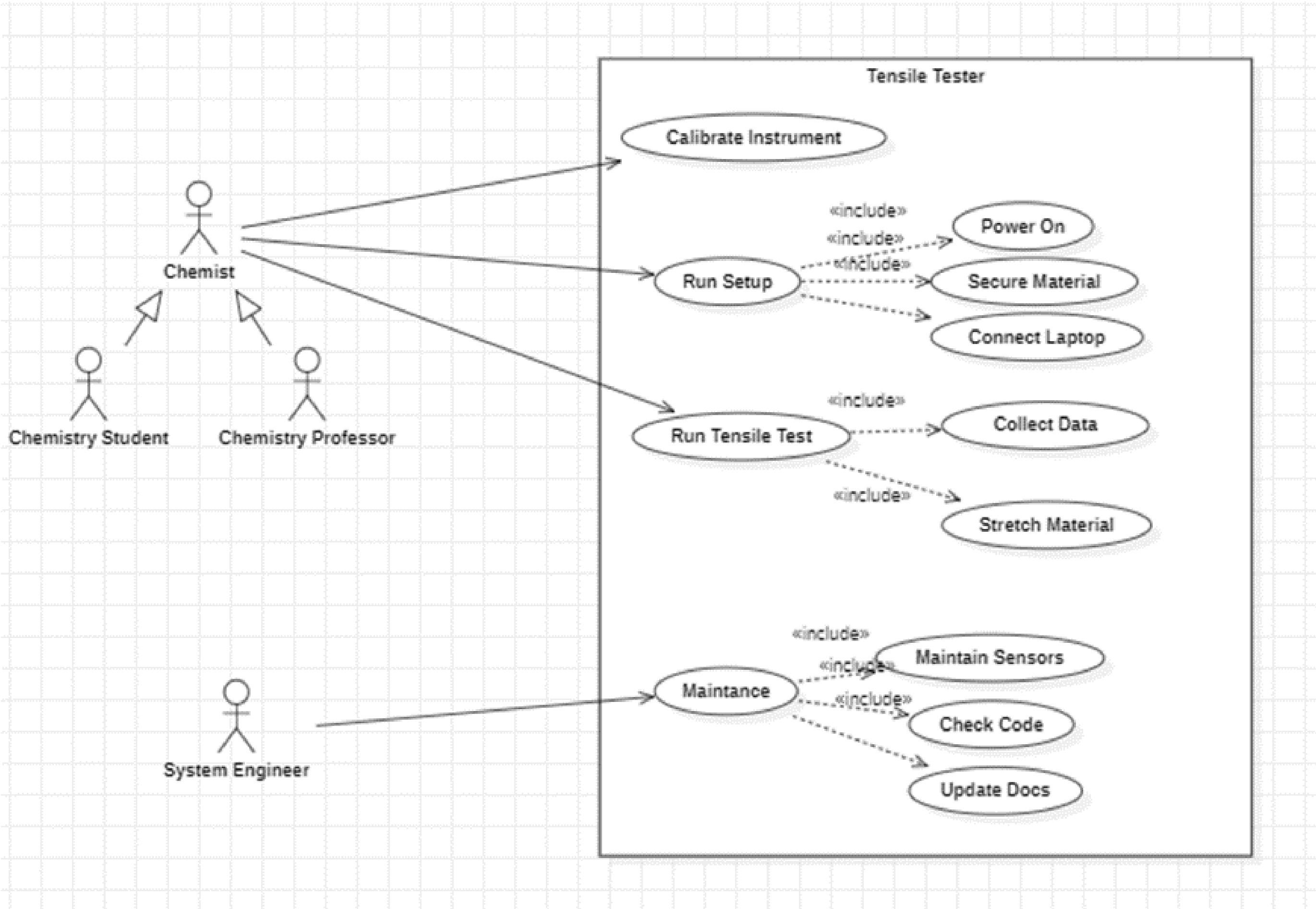

Figure 1. Model of the tensiometer system depicting system actors and the desired actions the system is required to support.

- **Step #2:** The chemistry student proceeds to run the tensile test function. The test material is secured using the clamps and the potentiometer software guides them through the data collection process.
- **Step #3:** The data is collected and the student proceeds to analyze the data for class.

Alternative Flow The error condition.

- **Step #1** The chemistry student performs calibration and preliminary setup (connect a laptop to the device).
- **Step #2** The chemistry student proceeds to run the tensile test function, The material is secured using the clamps and the potentiometer software tries to guide them through the data collection process, but the interface is clunky and confusing.
- **Step #3** The data collection process runs into problems. The test material keeps slipping off the clamps, horizontal movement near the load causes the sensor to report inaccurate measurements and a load sensor malfunction halts data collection. The students don't know how to resolve the issue and the there is no software to guide them through potential troubleshooting.

2.2 Constraints

For this project, system constraints have already been defined:

- **Time Constraint:** Completed and read to presentation/demonstrate by April 22nd
- **Budget:** Cost needs to be below $150. Going over budget will require strong justification as to the value added from the cost overrun.

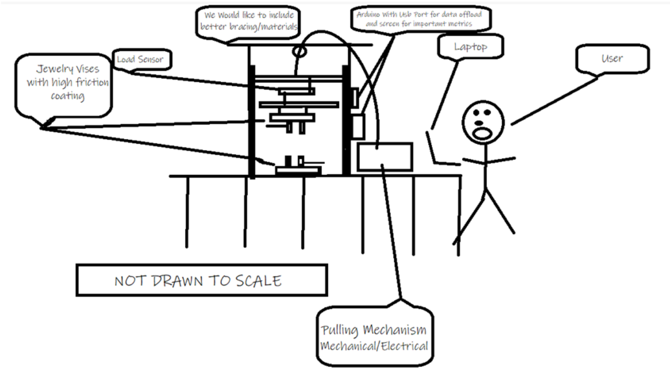

Figure 2. A logical sketch of the current system.

- **Replication:** Relatively straight-forward process to replicate your work, such that we can build out a lab of identical tensiometers.
- **Accessibility of Parts:** Parts need to be readily accessible, ship quickly (not on back order) and available from common part suppliers (e.g., Digikey, Mouser, Adafruit, SparkFun, Amazon). Avoid parts that are difficult to source.
- **Safety:** System must be safe to operate without significant training or supervision

3 Logical Design

See Figure 2 for design plan.

3.1 Design Justification

Besides being a priority for the sponsors, the design/solution was chosen for two main reasons: simplicity and accessibility to parts. Given recent shortages and shipping delays we decided to at least try and employ the best solution we could given our tight budget. Planning and working quickly also allows us to potentially return parts we don't need back to the manufacturers as well as narrow down our list of real-world alternatives (see References).

References

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