Logical Design Proposal UPGRADED TENSILE STRENGTH TESTER Team 7

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Activity Report

Abstract—Based on the existing tensiometer design, users are expected to be able to utilize the machine and stretch material to gather data. Before they can do so, there are many gaps in the existing system including one major gap which is the physical build quality of the system. It is important to address these kinds of gaps, as the overall data collected, and quality of user interface can and will be affected by it. We can look to improve on the physical design of the system by providing visuals for the user for better data collection, upgrading different components of our machine to lead to better user interaction and finding ways to better calibrate and generate more accurate distance for the user.

Index Terms—Uniaxial Tensiometer, System Analysis, Engineering Design

1 Background

Due to existing tensiometer testers being very expensive, we are given the task to create an affordable alternative. The existing machine has many gaps which include difficult utilization of the machine to properly collect data and inaccurate sensors. We would like to improve on it by making the system output accurate data and making data collection very smooth for the user. To enhance the overall user experience we can focus on making the overall physical interaction with the machine very straightforward such as guiding the user with instructions and displaying data to them. In addition, we will take into account of the temperature and humidity when calculating distance through the distance sensor to get more precise distance values. Lastly, we will upgrade the parts for the pulley system and clamps which will reduce setup times for the user.

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2 System Requirements & Constraints

- Perform Setup / Run Tensile Test / Collect Data: The user will secure the material in between the two clamps and plug in the system to their computer. The user will begin pulling the rope and stretching the material so data can be generated and collected.

- Maintain System: Making sure the sensors don't break and if they break, how they can be replaced. In addition, managing how the rope should properly be pulled and how to secure the clamps through documentation.

2.1 More Convenient Setup and User interface

• The desired functionality is to improve setup times and user experience for better accuracy while performing Setup and running the Tensile Test.

Normal Flow

This describes the default flow of the use case. Often referred to as the "happy path".

- **Step #1: The user will be prompted to secure the material on the clamps.**

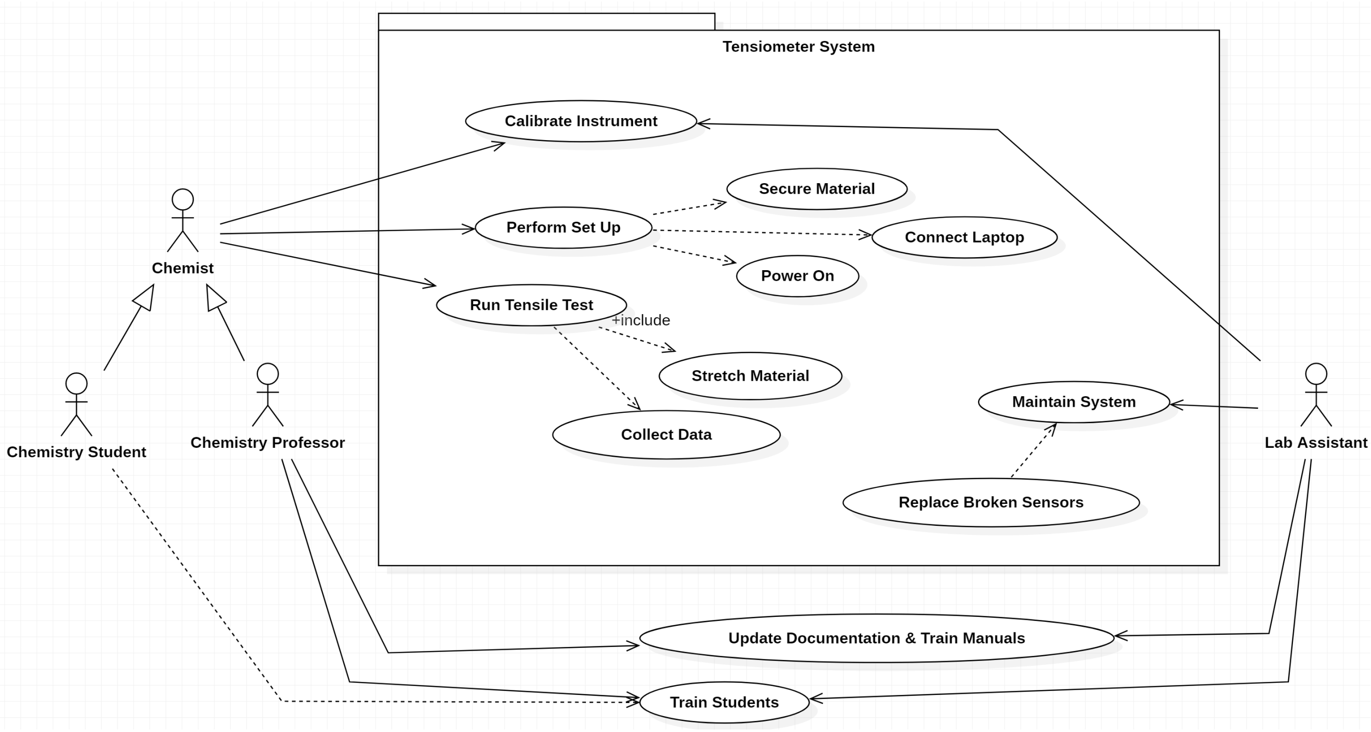

Figure 1. Use case model of the tensiometer system depicting system actors and the desire actions the system is required to support.

- **Step #2: The user will press a button and the machine will begin displaying the current distance and weight to them as they begin to pull.**
- **Step #3: The user stretches the material until it breaks and will collect data and generate a graph for user.**

Alternative Flow This describes what will happen under an error condition.

- **Step #1: The user will be prompted to secure the material on the clamps.**
- **Step #2: The user presses a button and the machine begins displaying the current distance and weight to them as they begin to pull. During the stretching process, the material exceeds 75 percent of the maximum load limit and the machine alerts them to stop.**
- **Step #3: The user stops stretching the material any further.**

2.2 Maintaining the System

The users will learn how to properly run the tensile test including how to secure material within the clamps and utilize the pulley system through provided documentation and instructions. If the machine components still end up breaking, the users will know how to replace them.

2.3 Constraints

These constraints are typically imposed by the project sponsor, end user, or by external regulations. Constraints restrict the design process and limit the potential solutions. For this project, system constraints have already been defined and have been given to you below:

- **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.
- **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

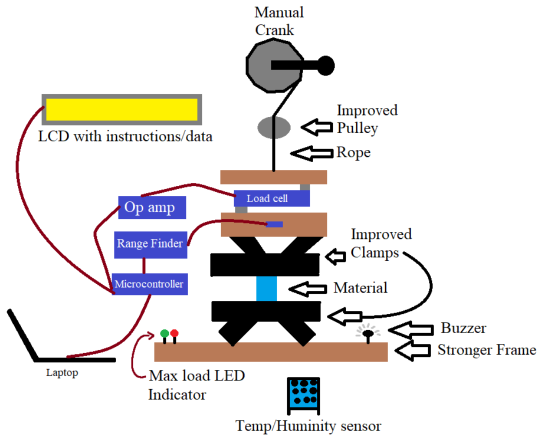

Figure 2. Provide an engineering sketch or model that visualizes your idea(s). Here is a logical sketch of the current system. The initial sketch should avoid any unnecessary details such as specific parts, but instead provide a logical view of the workings of the system.

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

Our idea to improve the system consists of upgrading the rope, clamps, pulley system (manual crank) and the overall stability of the physical structure. We would also like to add an LCD screen that would display instructions / data to the user. In addition, since distance is calculated through the speed of sound in the air which is affected by temperature and humidity, we will implement a temperature / humidity sensor. In order to increase accuracy, this will give us the current temperature and humidity so we can use that to better calibrate our distance sensor calculations. In addition to maintain the system and to prevent broken sensors, we will have a green LED when the user has not exceeded 75 percent of the maximum load capacity and a red LED and buzzer sound go off to alert the user to stop pulling.

3.1 Design Justification

This design was chosen versus other potential alternatives because when working with the system initially, those gaps stood out the most. We saw that it was very hard for a first time user to be able to know how to physically interact with the machine as well as collecting their data. We believe that our idea can help generate accurate results and provide a good user experience when collecting data. In addition, our design can help prevent parts from being broken so the system can be more long lasting.

References

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