

Mixed Reality Hardware for Hands On Virtual Science Labs

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Research question

As more and more classes transition online how can online science labs evolve and utilize new technologies to better emulate in person labs in order to close the gap in learning between online and in-person learning?

Challenge

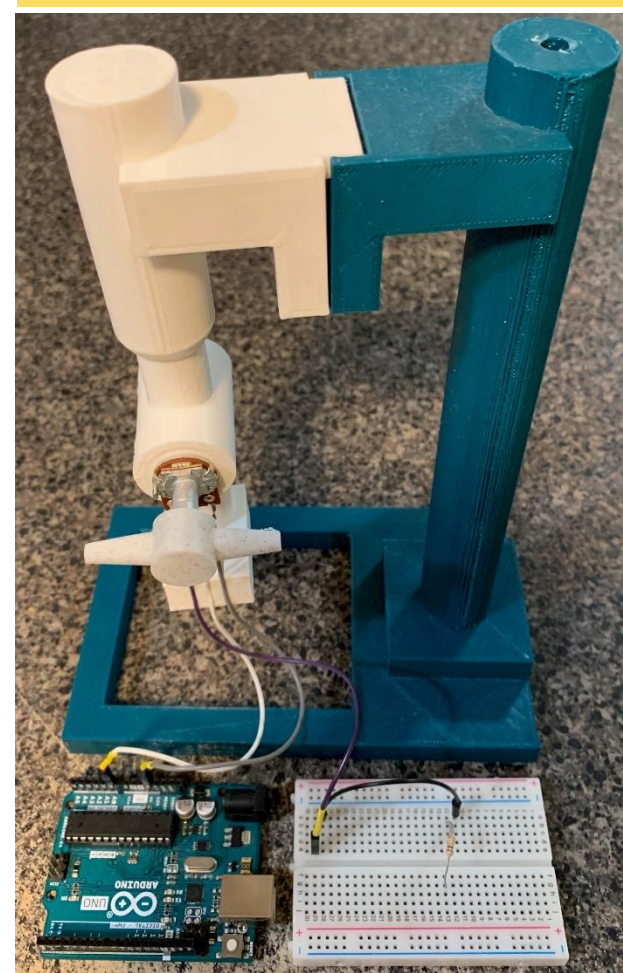
Online science labs when compared to their in-person counterparts lack in many aspects:

- Lack of real equipment to perform the lab experiments
- No sense of movement or temperature
- Limited to only seeing what is happening in the experiment not interacting physically

Solution

Building off work done the previous semester, the focus has shifted to focusing on the virtual titration lab and preparing it for user studies with new GUI and data handling capabilities. Along with this a physical burette with a potentiometer is being developed to add more tactile feedback to this lab.

Potentiometer Burette Hardware



- Here is the physical burette set up.
- It is 3D printed and contains a potentiometer which can interact with the burette in the titration virtual lab
- The physical burette here controls the flow of liquid in the virtual lab

Pre/Post Lab Questions

- Example of pre/post lab questions
- These are crucial to data collection for the user studies on the virtual lab
- They test the user on titration related questions both before and after the experiment, all results are recorded automatically
- The pre/post-test results as well as time per question and other factors will help determine the effectiveness of this virtual titration lab in teaching titration to students

In the box below, drag and drop the particles that make up an aqueous solution of HCl. For each type of particle you think is in the solution, drag and drop at least three of that kind of particle. For example, if you think the solution contains Na⁺ ions, you would drag and drop at least three Na⁺ ions. However, you do not need more than 5. To delete a particle, drag it anywhere outside of the answer box.

Order the following substances from most acidic to most basic on the pH scale by dragging and dropping each item to the appropriate box on the scale.

Unity Virtual Titration Lab



The photo above is the main screen for the titration Unity Lab Scene (Non-VR)

Data Collection From User Studies

Username

Please enter the ID given to you by the experimenter.

Please enter your FIRST and LAST name.

Next

- Starting screen for lab
- Creates a CSV file with user data based on the name/id for future analysis

Progress

- Titration experience has been thoroughly developed including GUI, pre and post questions, and data collection/handling
- Design of a burette with a potentiometer for future integration into virtual labs has been completed

Future User Studies

- At this moment work the virtual titration lab non-virtual reality experiment is being prepped for user studies
- These studies will help determine the effectiveness of a virtual lab on student's ability to learn Chemistry topics, specifically a titration experiment
- Also, the burette with potentiometer shown can be integrated into the titration lab to give an element of tactile feedback that is connected to the burette in game