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Value Proposition

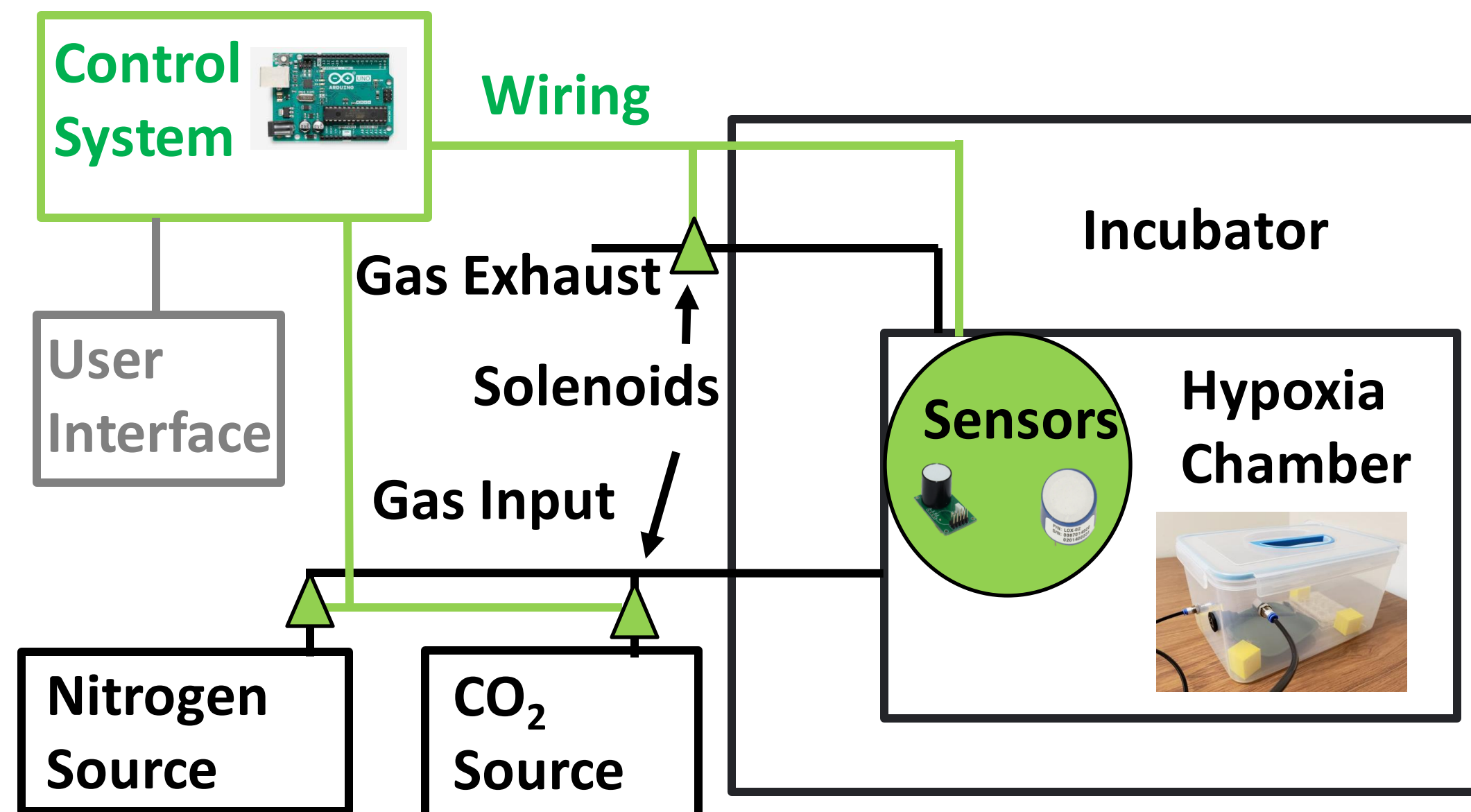
Stem cells naturally grow in a low-oxygen environment and simulating this environment allows researchers to efficiently cultivate stem cells and conduct research regarding the effect of hypoxic environments on the cells' development.

Commercial hypoxia chambers are expensive. This project aims to develop a hypoxia chamber that is both inexpensive and simple so that other researchers can utilize our technology.

Key Requirements

- Maintain O₂ level between 1% - 21% and CO₂ level at 5% for a min. period of 21 days
- Fits inside standard incubator and maintains incubator conditions
- Big enough to contain 4 well culture plates
- Materials inside chamber need to be able to be sterilized
- Must have UI to control/monitor chamber

Concept Development



Objective

The objective of this project is to design and manufacture a low-cost, controllable hypoxia chamber to examine stem cell behavior.

Hypoxia Chamber Design

Humidity Control System
A tray of water and a porous shelf maintain chamber humidity.

Chamber
A plastic box with holes drilled for gas and wiring.

User Interface
Python-coded GUI for input and display.

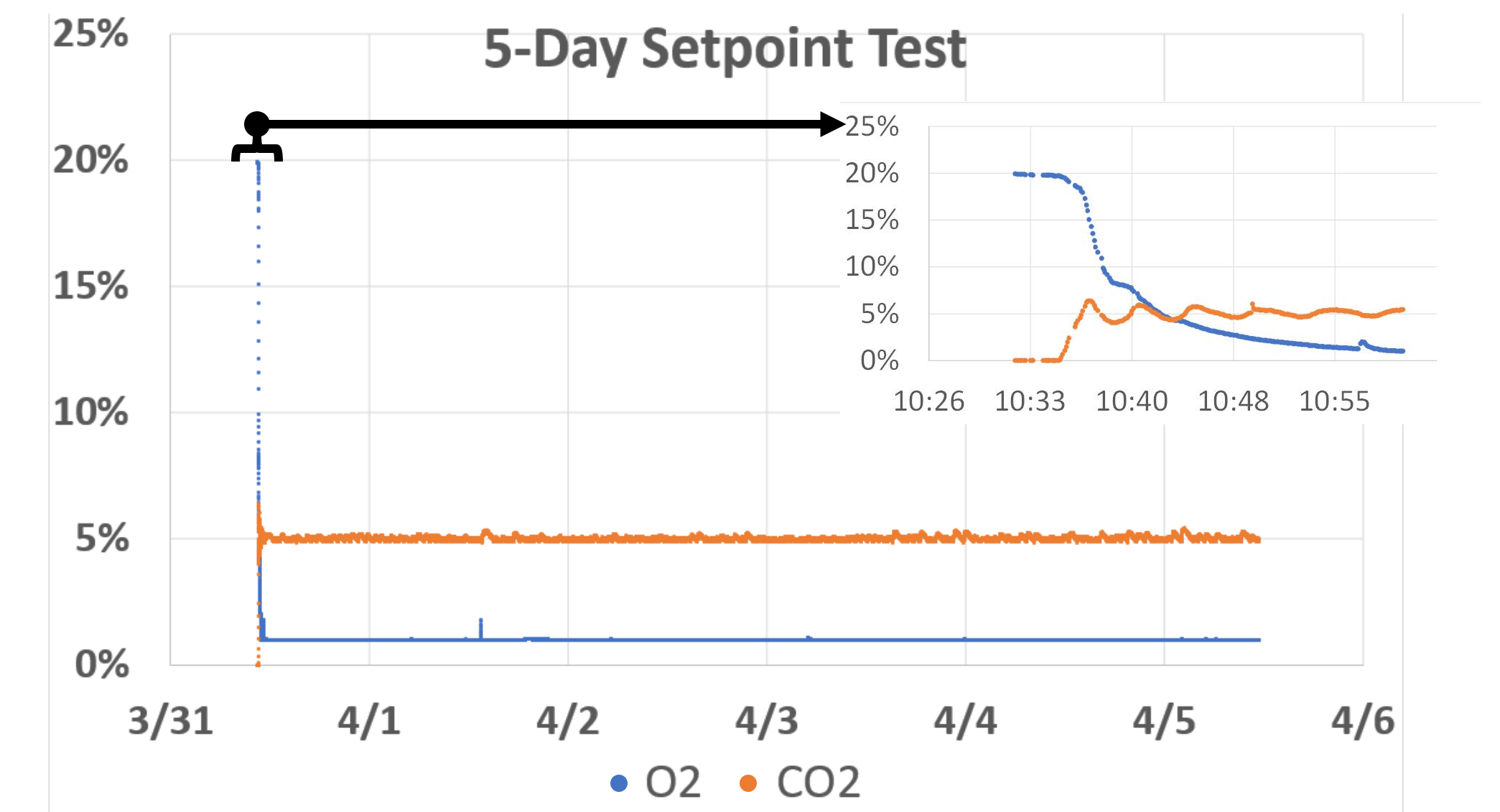
Sensor Housing
3-D printed housing to hold the sensors and wiring.

Sensors
Sense O₂, humidity, CO₂, temperature, & pressure.

Control System
An Arduino with a PCB uses sensors and solenoids to control the environment and is housed in a 3-D printed box.

Final Product
A low-cost, easy-to-manufacture chamber. Total cost ≈ \$650

Validation



- Multiple validation tests were conducted to verify system integrity and that setpoints were maintained.
- Temperature and humidity were tested within the incubator.

Conclusions & Future Work

We have successfully designed a low-cost hypoxia chamber. It is considerably cheaper than commercial systems and maintains all the required setpoints. Looking forward, more validation testing would allow for further points of improvement to be identified, and changes to the GUI could be made to implement graphing of the current conditions in the chamber.

