

Low-cost, Controllable Hypoxia Chamber for Exploring Stem Cell Behavior

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Objective

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

Background & Value Proposition

- A crucial component to conducting stem cell research is maintaining a hypoxic growing environment. Stem cells naturally grow in a low-oxygen environment and simulating this environment allows researchers to more efficiently cultivate stem cells and conduct research regarding the effect of low-oxygen environments on the cells' development.
- However, current commercial hypoxia chambers are expensive. This project aims to develop a hypoxia chamber that is both inexpensive and simple. The results of this project will include the hypoxia chamber design and physical product as well as a published paper detailing our design and construction process. This will allow other researchers to utilize our technology and ideas.

Key Requirements

Functionality:

- Maintain oxygen levels between 1% and 21%
- Maintain CO2 levels at 5%

Durability:

- Maintain hypoxic environment for 21 days min.
- Reusable for multiple experiments

Working Environment:

- Function within incubator conditions

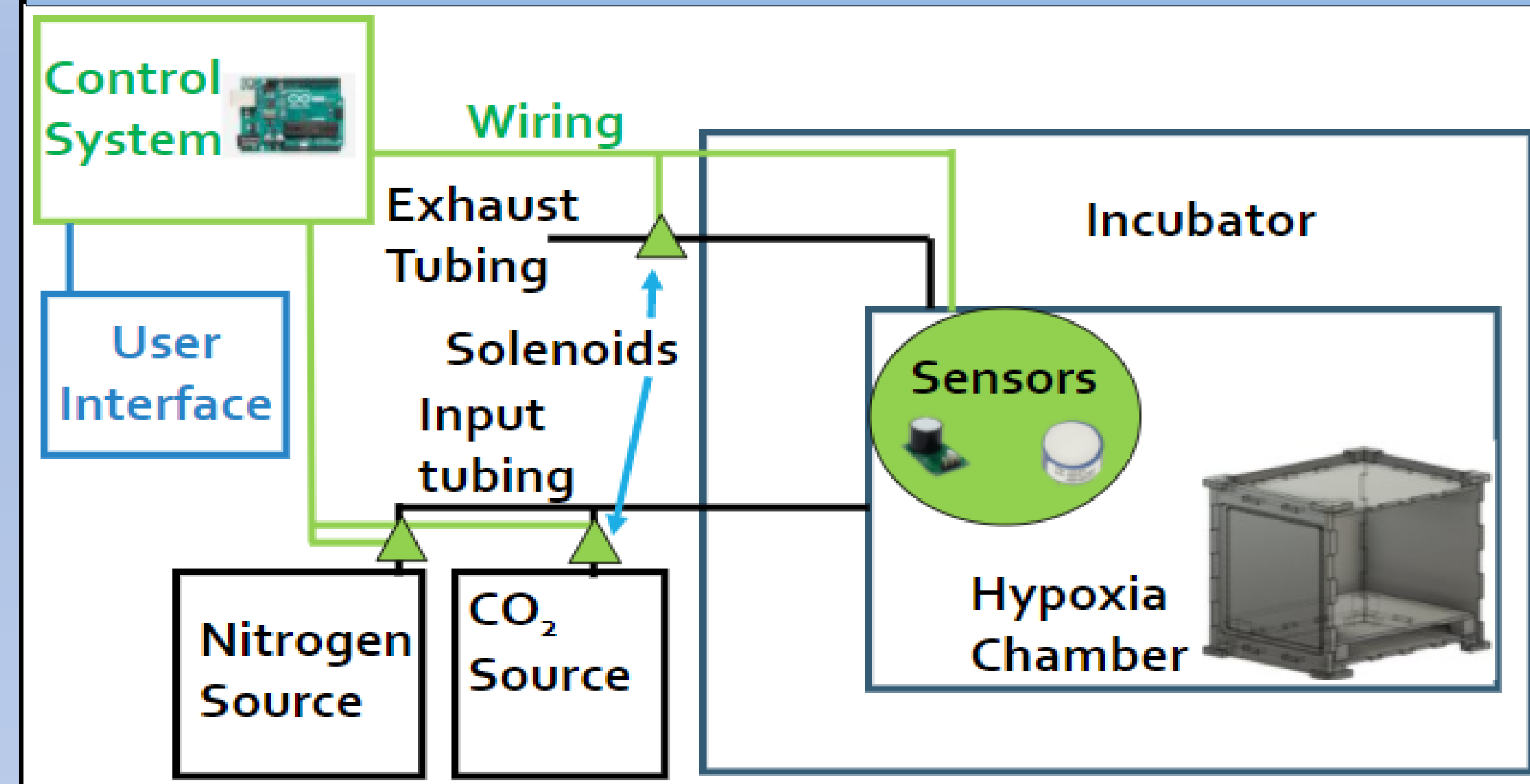
Logistics

- Have GUI for controlling & monitoring chamber
- Low-cost, simple & reproducible manufacturing

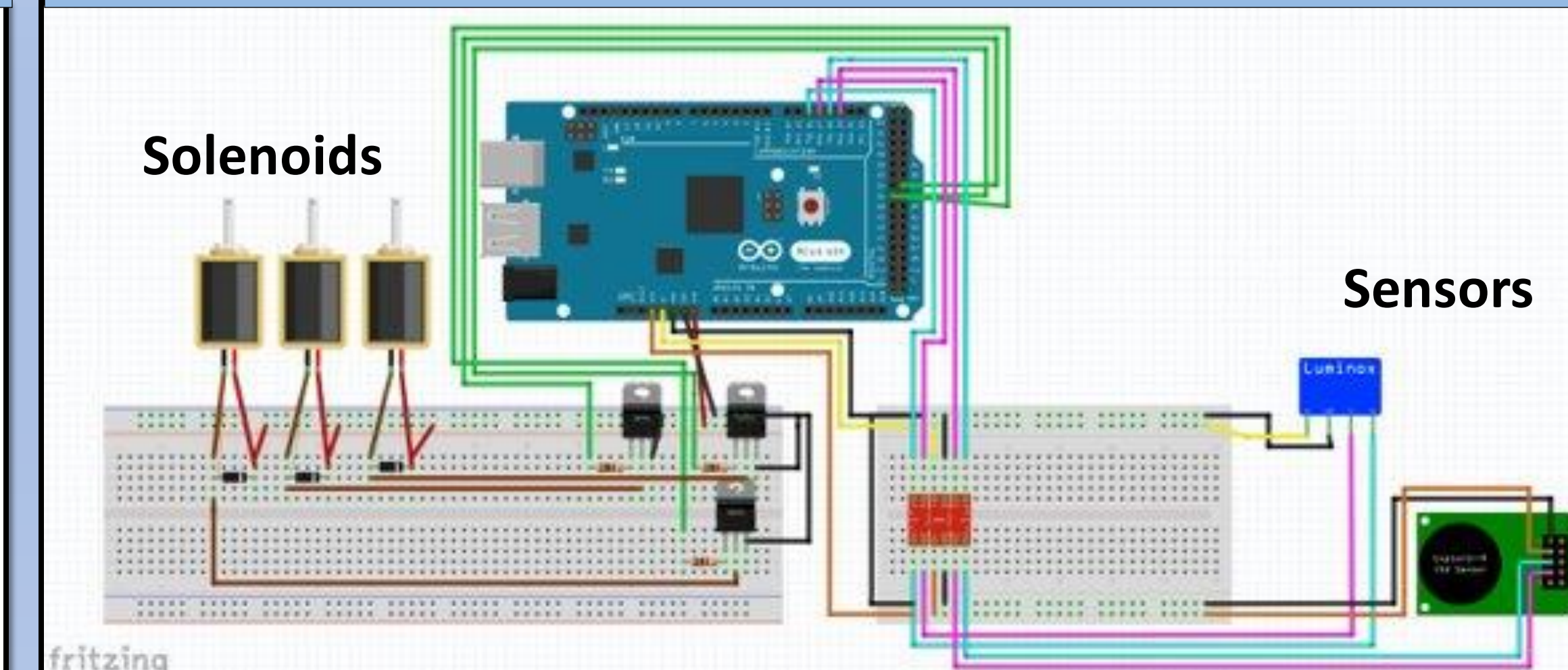
Physical Properties:

- Large enough to fit at least 4 well plates
- Transparent

Concept Development



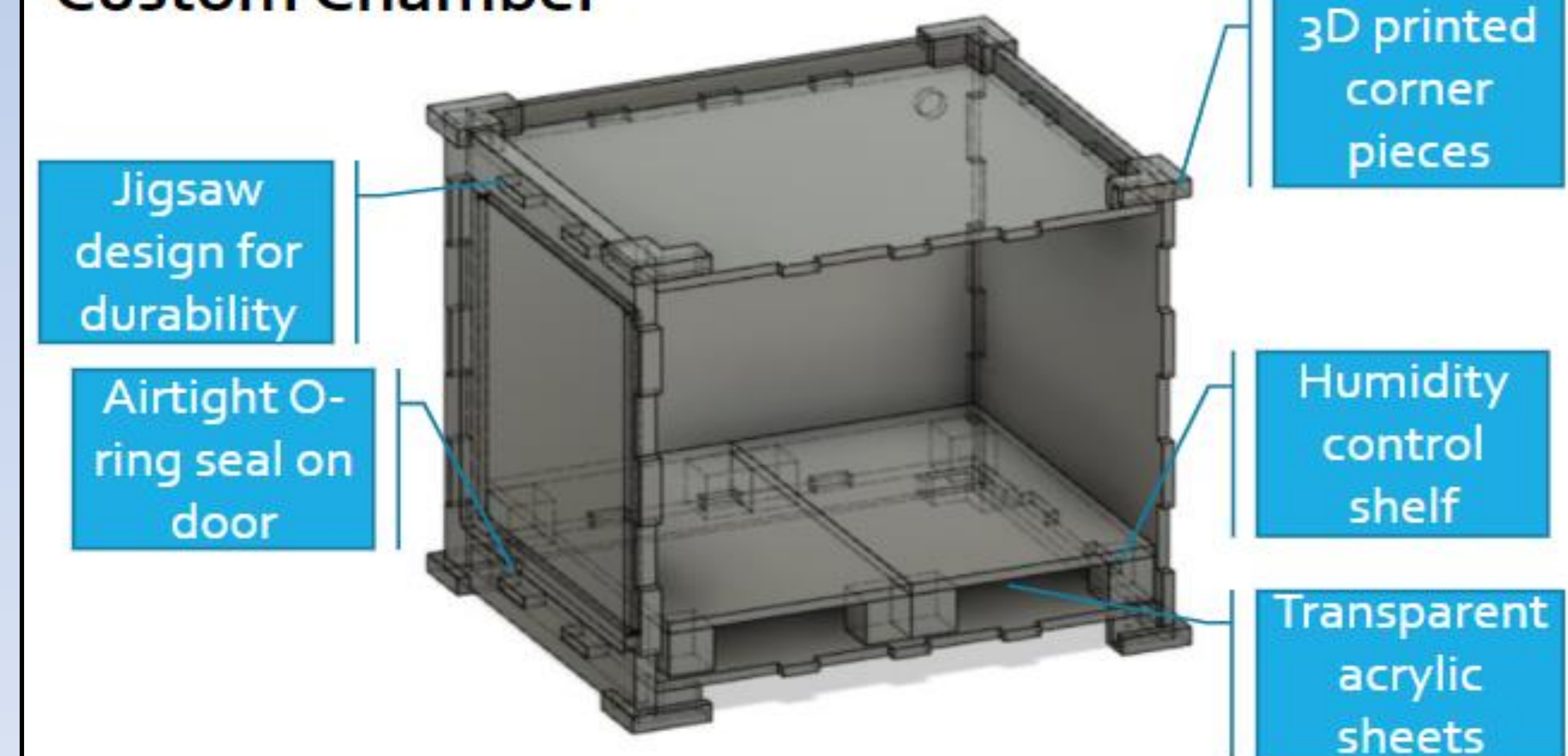
Control System



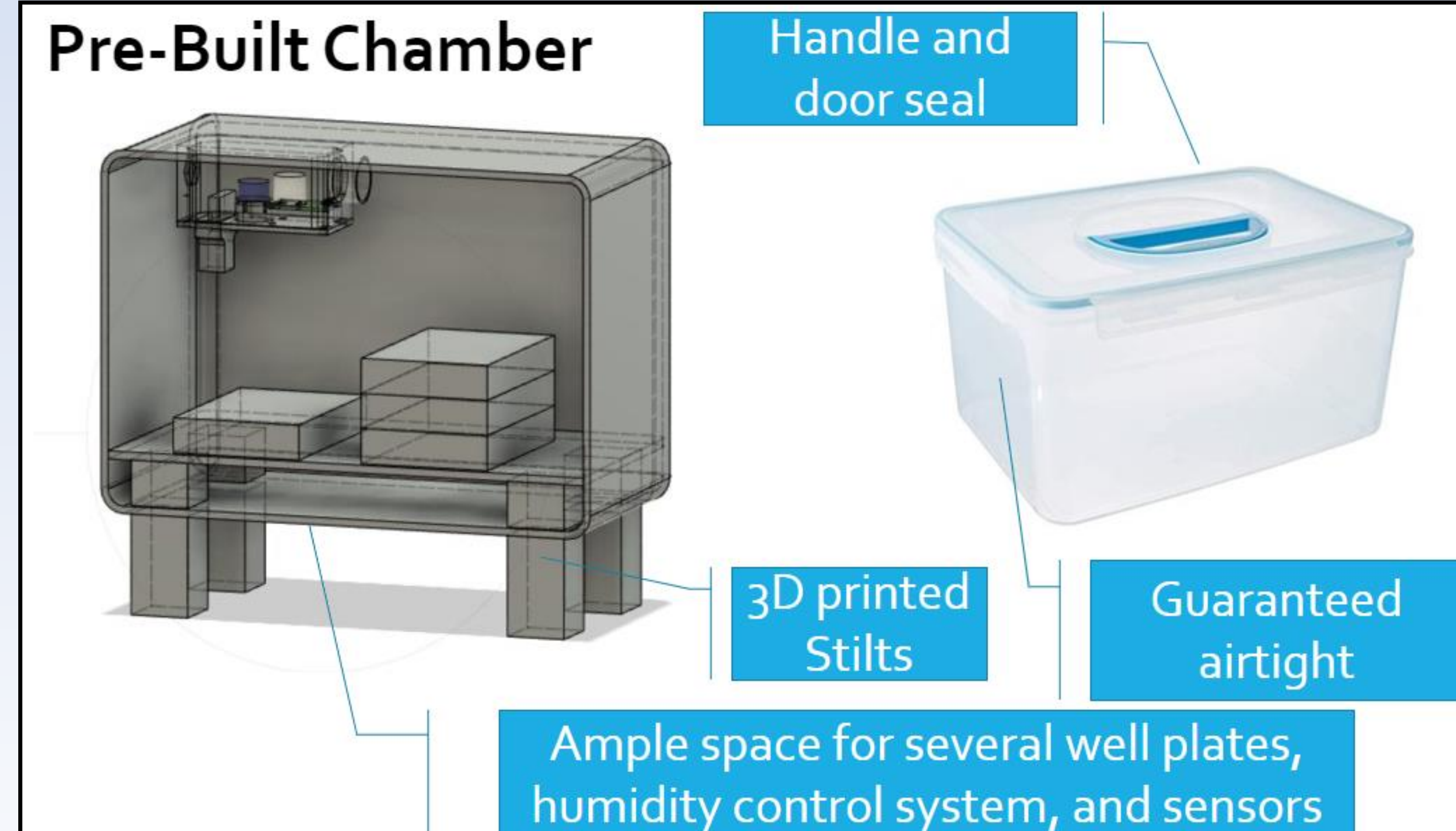
- Solenoids controlled by Arduino using diodes, BJT transistors, and resistors
- O2 and CO2 sensors controlled by Arduino

Chamber Designs

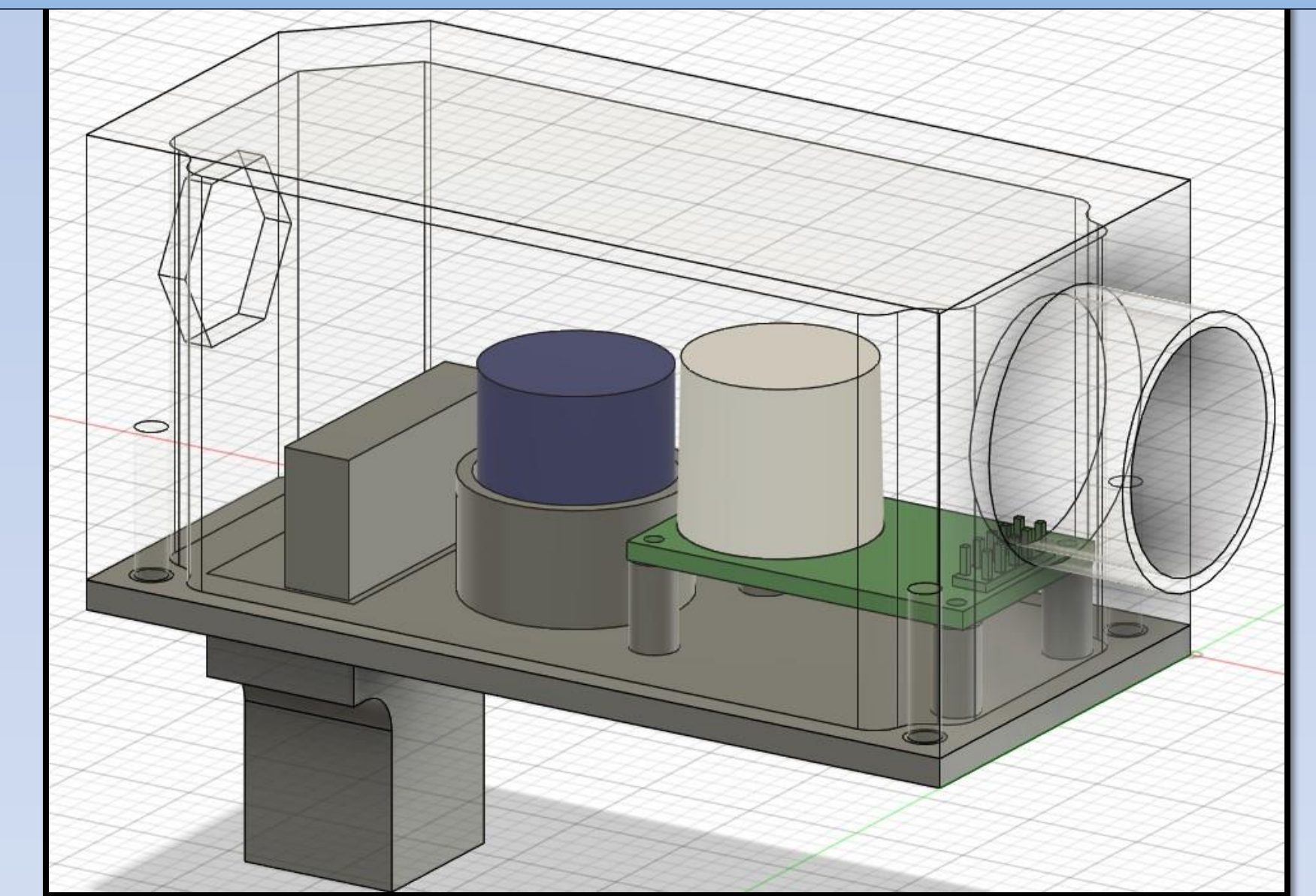
Custom Chamber



Pre-Built Chamber



Sensor Housing



Current Progress

- Purchased necessary materials for custom chamber, pre-built chamber, and control system
- Begun manufacturing of both chamber options
- Create control circuit for Solenoid Valves
- Test CO2 and O2 sensors using a candle to modify gas levels
- Testing the materials for the custom chamber

Looking Forward

- Control solenoids based on CO2 and O2 readings
- Assemble pre-built chamber and test if it is airtight
- Determine if the custom chamber is a viable option
- Create a PCB for the solenoid control