To: Dr. Zachary Lerner
cc: Dr. Sarah Oman
From: Team 5
Subject: Capstone Progress Update
Date: 18 June 2020

Introduction

Team 5 has made significant progress in the 486 C section of capstone. This memo will outline our current physical system, progress from 476 C, and justification of decisions made by the team. As the client, your input is valuable to the objective of the project. With changing circumstances we would greatly appreciate your input and any feedback you can give us. Please take a look at our progress and let us know of any improvements we can make.

Progress from 476C

Progress that has been made since the end of the previous semester of capstone includes modifications to the design, a filter capacity indication system using Arduino, the material and filter selection for the fume hood, as well as ideas for manufacturing and building the physical model.

The pyramidal top will be attached to the rectangular working space specified earlier in the semester. A pressure differential system will give real time filter updates to maintain a safe operational environment. The filter chosen is the Levoit lv-h132 and the walls will be made from Polyethylene. If this system is sufficient please let us know.

Currently the manufacturing ideas include making each section of the device separately and then using a combination of bolts and a sealant to ensure that the inside of the device will be airtight to ensure that the air quality within the device stays at or above the minimum required level. The manufacturing processes that are being looked at are polymer casting, vacuum molding, extrusion molding and rotational molding. A question we had for you was the capability of your lab in regards to the manufacturing process. We could very easily create a finalized bill of materials with step by step instructions on how to manufacture if your lab is able to assemble the physical system at a later date. We look forward to hearing your feedback.

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Current State of Physical System

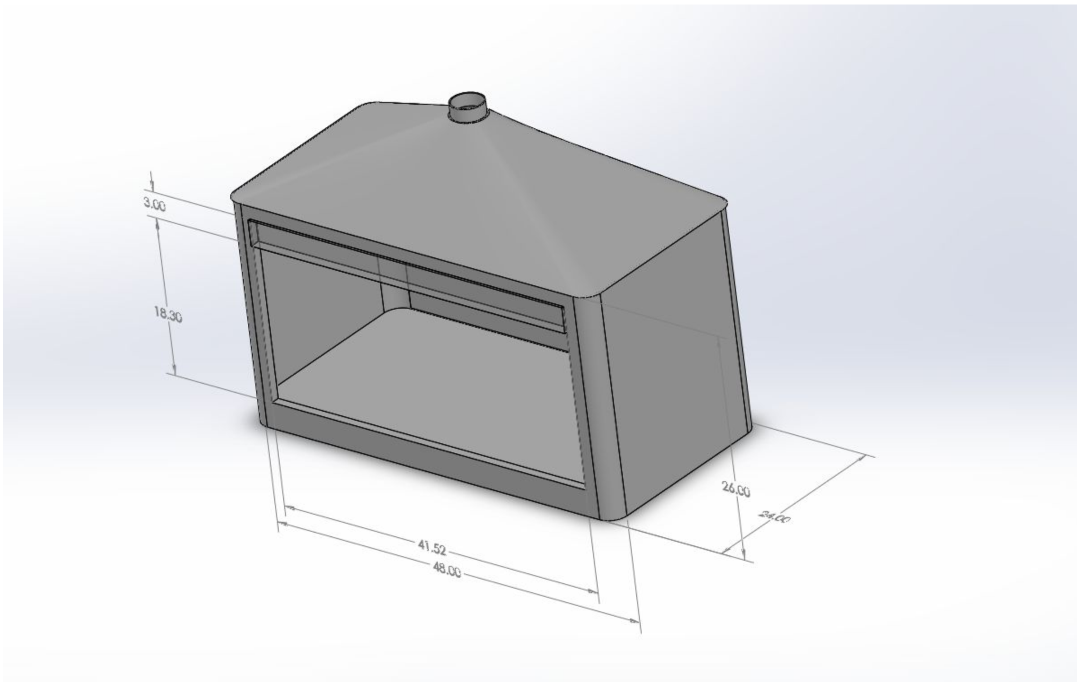

Figure 1. CAD Model of Current Design

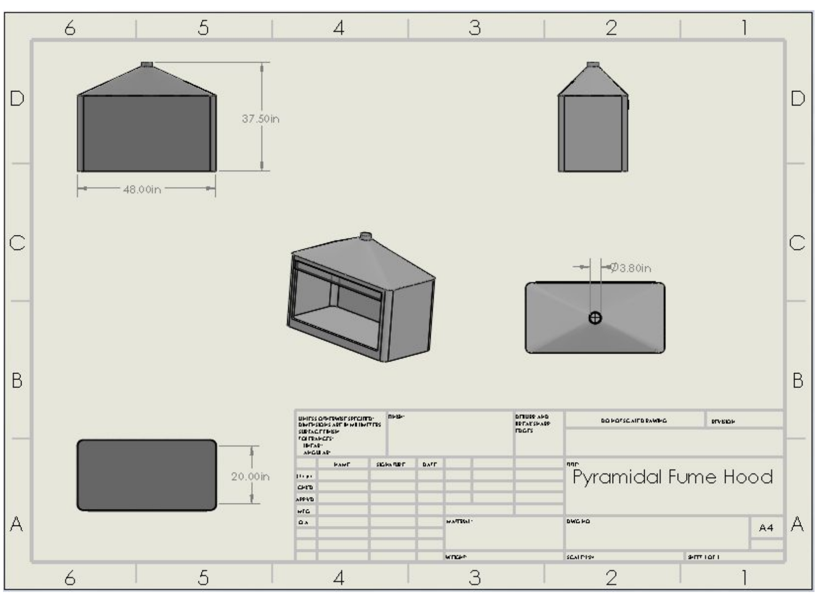

Figure 2. CAD Drawing of Current Design

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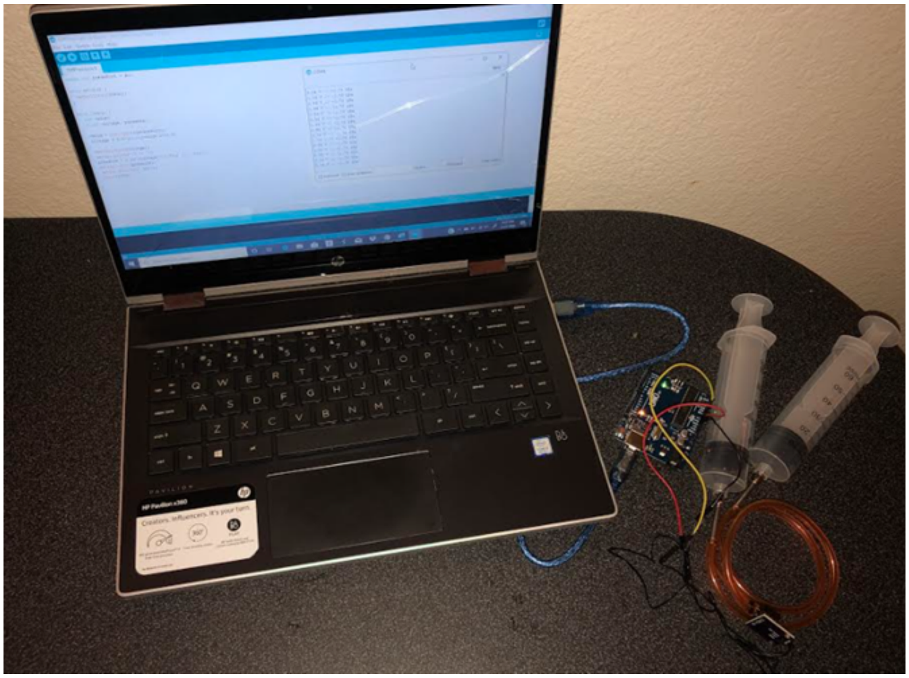

Figure 3. Pressure Differential with Arduino Uno Board

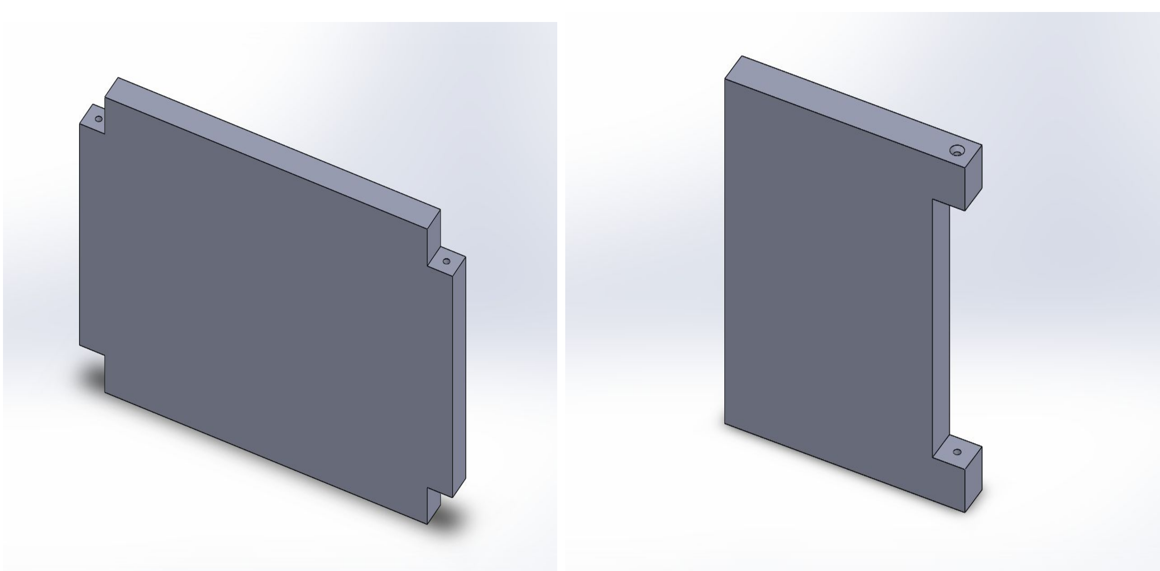

Figure 5 & 6: Fume hood back and side wall modification

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Product Justifications

Pyramidal Hood

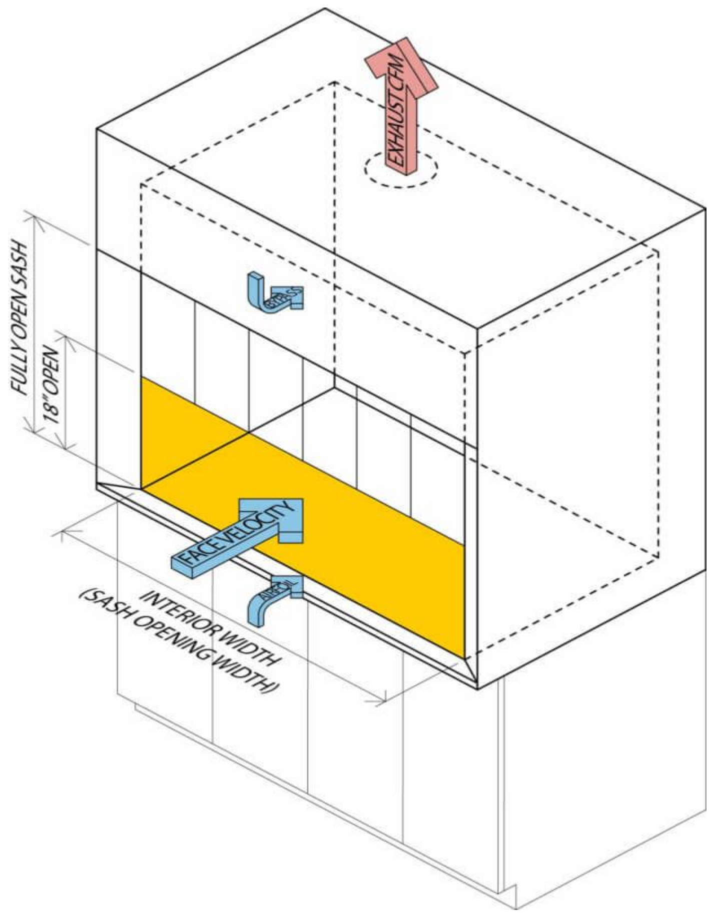

Figure 7. Airflow through Main Working Space

Figure 7 demonstrates the airflow through the main working space of the design. While the box shape is simple and effective, the team wanted to ensure adequate and consistent airflow through the entire system. A box shape can experience dead zones of airflow where the velocity would become stagnant. This would lead to dangerous accumulation of carbon fiber particulates as well as stagnation pressure drops at various points in the system.

To eliminate this threat and improve the overall design, a pyramidal fume hood top was chosen to be attached to the exhauster. The shape is demonstrated in Figure 8. The exhauster being used has one main hose for airflow rather than several points to create a distributed flow.

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Therefore, it would be more efficient to alter the top of the fume hood to create a diffusion of velocity into the exhauster.

Figure 8. Pyramidal Fume Hood Top

Material Selection - <u>Polyethylene</u>

Figure 9. Polyethylene Fume Hood

Polyethylene is a widely used material selection for laboratory fume hoods. This material is durable, economical, and highly chemically resistant. There are different densities available that can be chosen based on project specification. This is a viable option for the current project as this material would be easily damaged by carbon fiber. For a general density of approximately 955 kg/m^3, the yield strength provided would be roughly 2.7x10^7 Pascals. This material has

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been selected by the team to provide durable and lightweight walls that will not be easily damaged by the carbon fiber particulates.

Filter- Levoit lv-h132

The team was put in charge of selecting the location and type of filter for the fume hood. An air filter was the most practical and cost effective option. High efficiency filters describe HEPA and ULPA filter types. HEPA filters are able to remove 99.97% of all particulates from air. This air filter will be able to remove the carbon fiber particulates from the work space very effectively. Depending on the use, the life expectancy should be roughly five years.

The location of the filter will be at the attachment of the exhauster hose and the top of the fume hood. This location was chosen because it will remove the carbon fiber particulates before the airflow exits the system through the exhauster. This will eliminate any threat from the particulates to the exhauster. The filter will be easily accessible by detaching the hose when the filter needs to be changed.

Figure 10. HEPA Air Filter