



Neu

Personal air purifier for office workspaces.

Process Document



Eduardo Soto-Danseco
IDES3310
Stephen Field
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Introduction

This document will show the design process of a semester-long third year studio project. It has been the most thorough design exercise I have completed to date. The task was to design a personal air purifier. The first stage was research that was completed in a group setting. The research phase was important for understanding all of the design considerations for a product before actually designing one. After this phase, the rest of the project was completed individually. Next, design briefs were established individually. After this came the ideation phase - this is where the design began to take shape. Once specific operations and features were developed, prototypes were created for user testing. Testing validated some ideas and pointed out flaws in others. Letting people use test models was crucial for seeing whether a design would be successful or not. Results from testing were then incorporated into the definitive design. After getting feedback on the definitive design, the design was developed further before constructing the final looks-like model.

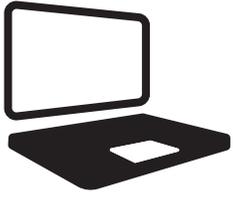
Design Brief

Air pollution has become an increasingly relevant issue around the world. Most people are aware that it is a big problem, but few people think about the immediate health impacts from the quality of the air they are breathing, even indoors. There is a growing market for personal air purifiers. This document will follow the design process for a personal air purifier. Most air purifiers currently on the market are meant for the home and other larger spaces. There is an unsaturated market for personal air purifiers. I plan on designing a personal air purifier for office workers. It will be used in personal workstations like cubicles, office desks, etc. This air purifier must be easy to set up in order to direct clean air towards you. Changing the filter is a crucial operation for ensuring that the user gets clean air - it must be easy to know when and how to change filters.



Workstations
<http://ixiqi.co/image>
<http://www.mak-mis.com/easy-tips-to-organize-your-workbench/work-desk-4/>

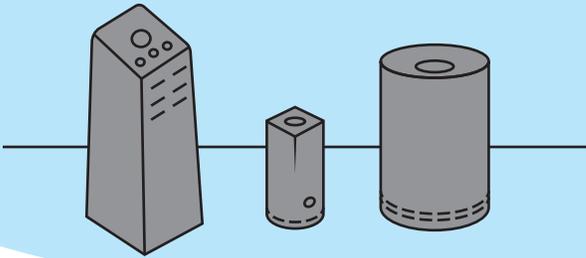
Research



Secondary Research

Exploring Existing Markets

Looked at top brands, contexts of use/target markets, sizes and shapes, price range, and industry standards.



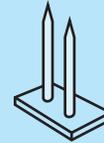
Researching Types of Filters



HEPA



CHARCOAL



IONIZERS



UV-C

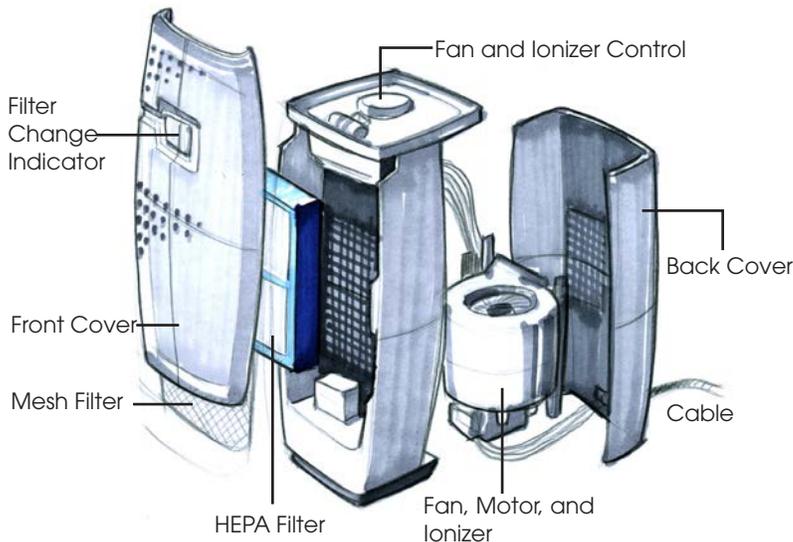


PLASMA WAVE

To understand how they work and how effective each filter is.



Disassembling an existing product



This provided a better understanding of how air purifiers work; it showed component sizes and arrangement, materials used, assembly, and fastening techniques.

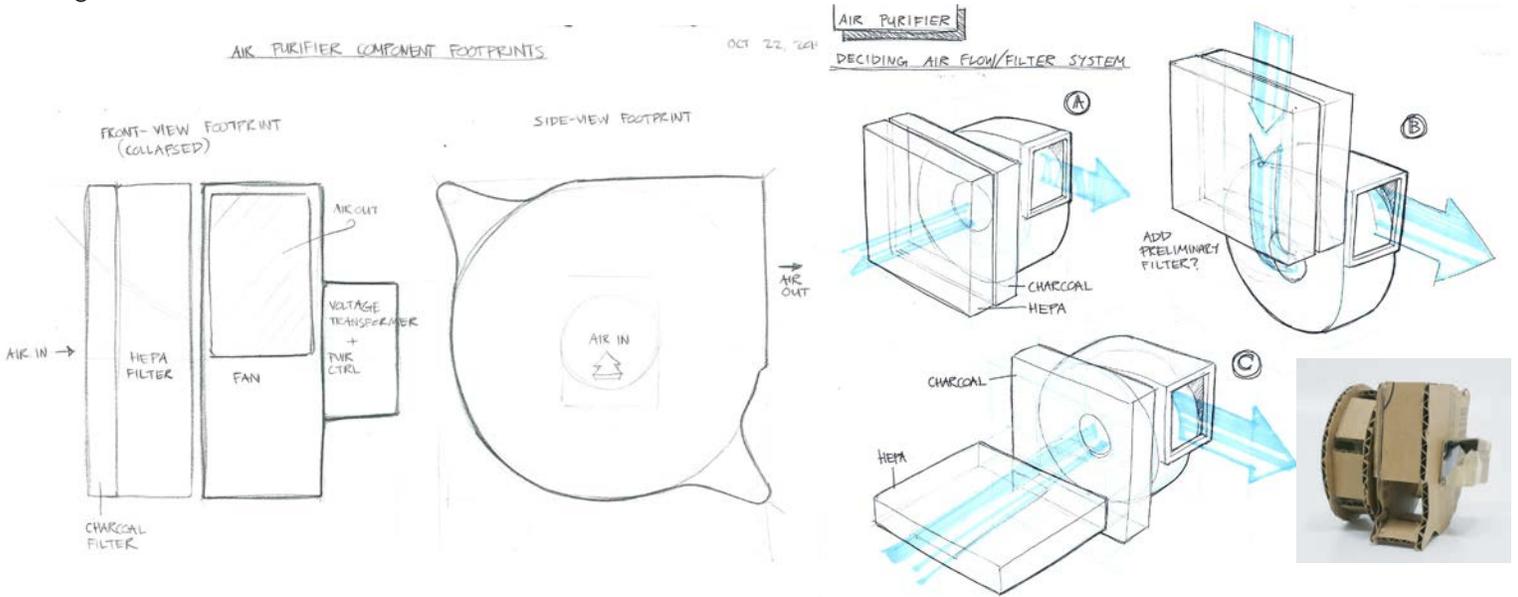
After this step, additional research was done on types of fans in order to find one that gave the best size to power ratio.

It was important to do secondary research before designing because it gave insights and considerations that were used to guide product development.

Initial Ideation

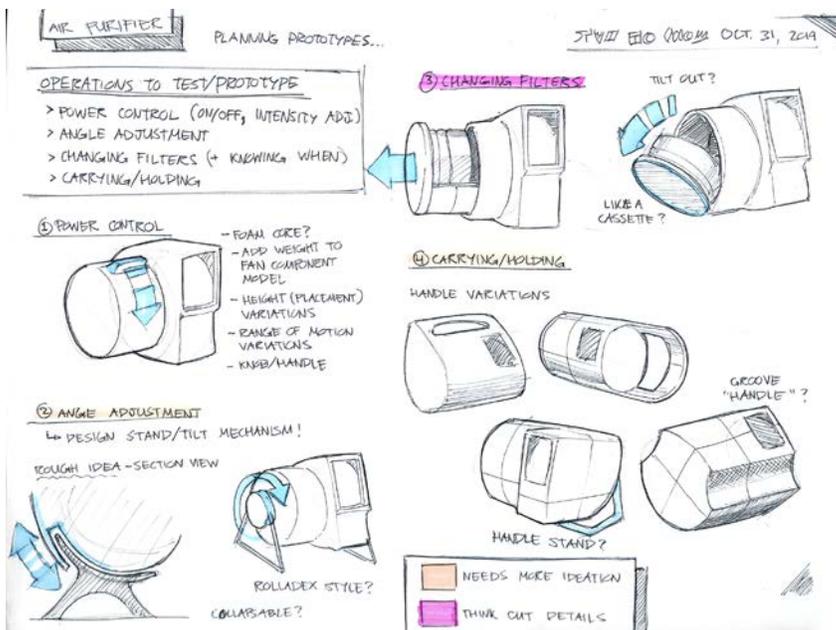
Internal Components

Determining the internals early in process allowed for more focus on usability and aesthetics instead of technology. The internals were sketched in a 1:1 scale, then quickly modeled with cardboard. This allowed for ideation to be more grounded and realistic.

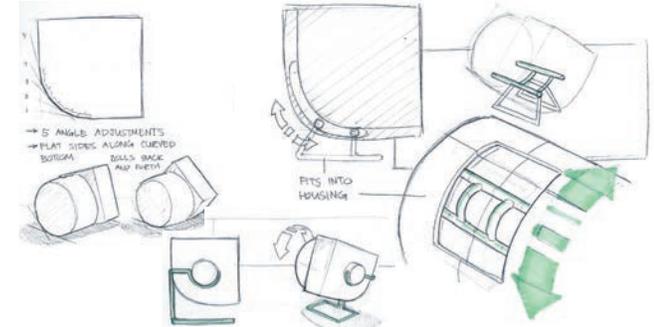


Functions to Test...

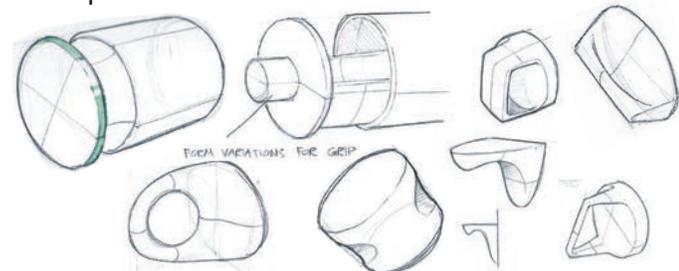
Deciding the internal components created a basic footprint of what the product's form could be. The next step was identifying key functions to design and test. They were initially identified as power control (on/off, intensity control), angle adjustment, changing filters, and carrying/holding. After sketching and rapid prototyping, some features were decided, and the list of things to test was shortened. User testing would consist of angle adjustment mechanisms and varying handle designs for pulling out the filter cartridge.



Tilt Mechanisms

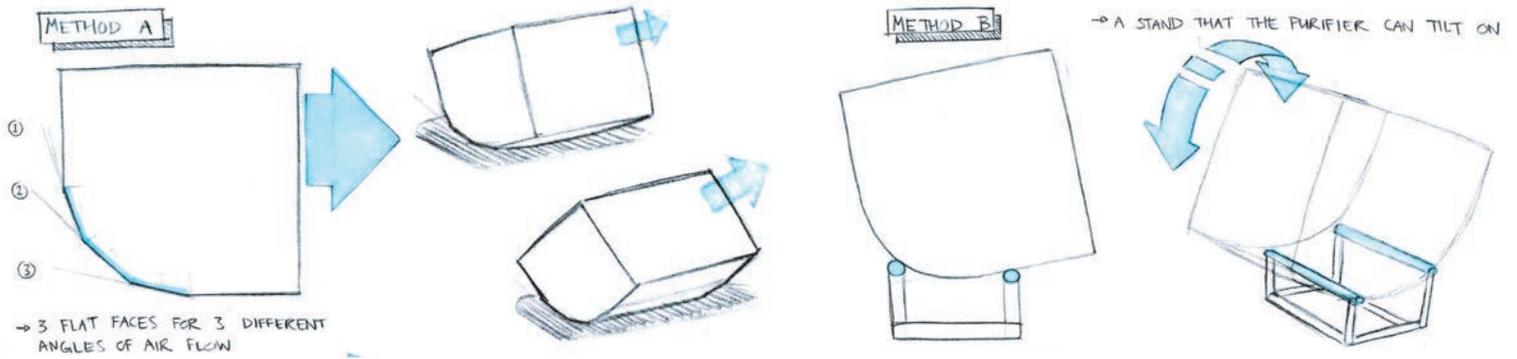


Grip Variations



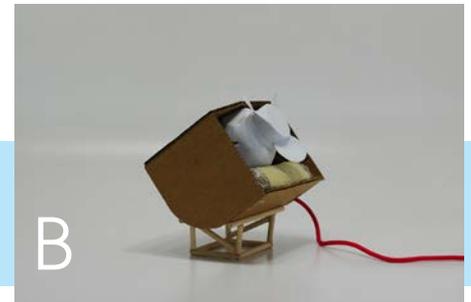
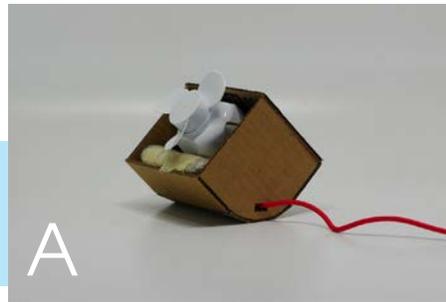
User Testing

Tilting Methods



Tilting Method Sketches

User testing was set up at a mock workstation where participants were instructed to use models to direct air toward their faces. The test models were weighted and housed a fan which simulated the feel of what it would actually be like to adjust the angle on the real product. A total of eight design students were part of the user testing. The tilting methods shown above were evaluated and compared through questionnaires and conversation.



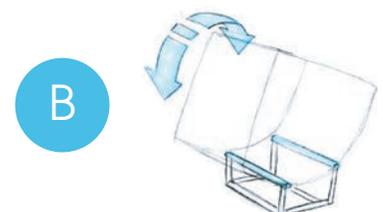
Test set-up and test models



Participant Interactions

Overall, participants found that Method B allowed for more angles of adjustment than Method A. Every participant completed the task faster with the stand system than the flat sides. Two participants noted that they liked using the stand better because it looked like it was displaying the product, which made it feel more special.

Chosen Method



User Testing

Handles to Open Filter Cartridge



Test Models

The second test compared handles for pulling out the filter cartridge. This test evaluated each handle's comfort and affordances. Each model was very different, which resulted in very mixed feedback from participants. Users with larger hands had a strong preference for handle A, while most other participants preferred handle B for its size and aesthetic values.



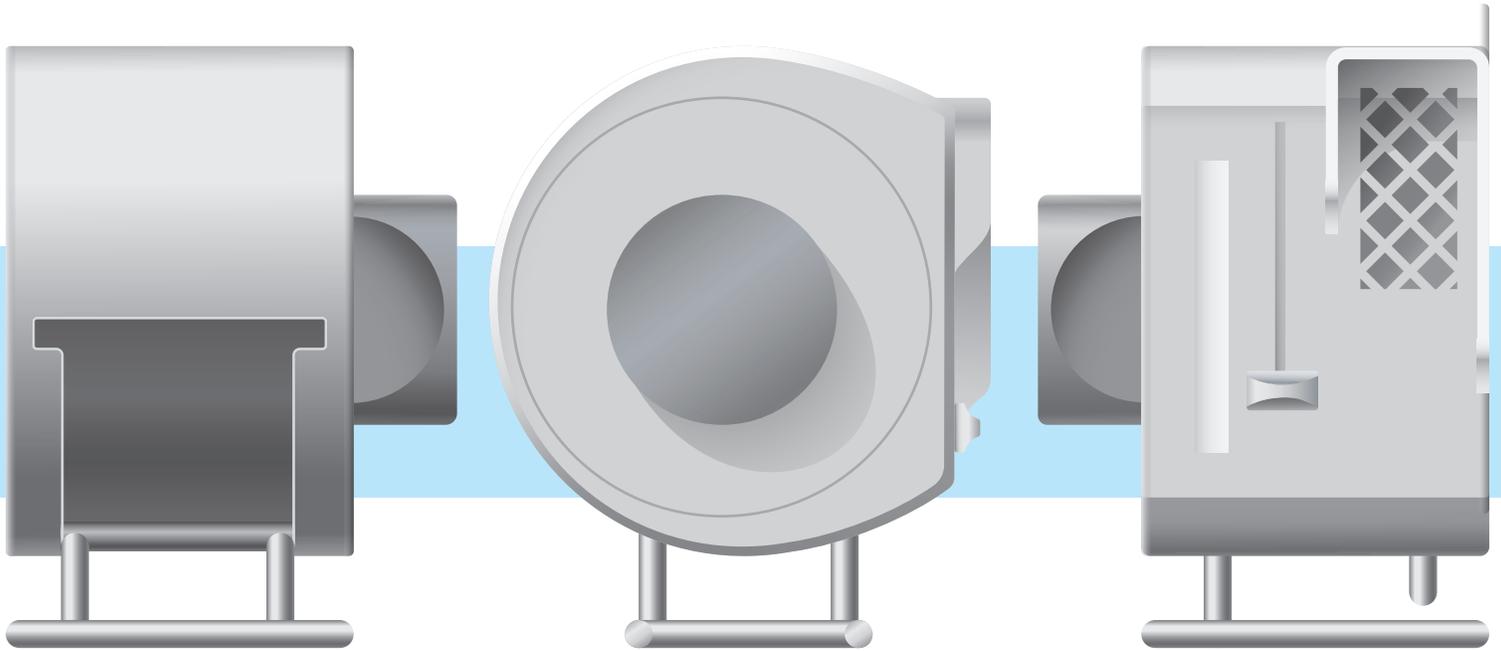
Participants using test models

User interactions revealed that none of the handles had a strong enough affordance to pull the cartridge out - almost every participant's instinct was to twist the handles. Some users asked if they were supposed to twist, or if there would be a twist function incorporated into the design. Even participants who knew to pull noted that handles B and C looked and felt like they should be twisted. This meant that the form of the handle had to be rethought.

Summary of Findings

- Handle B was chosen based on size and comfort, but most people twisted instead of pulling.
- The form must be developed to give it the affordance to pull.

Definitive Design

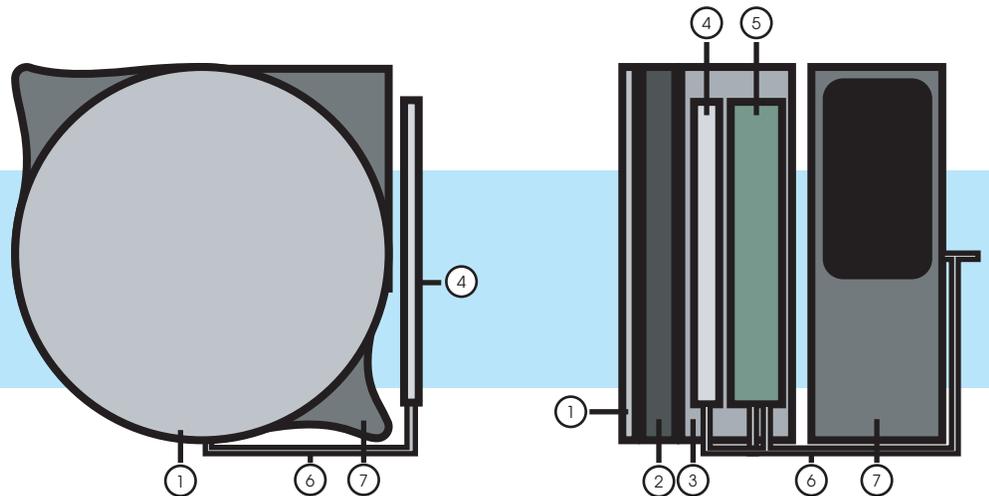


Definitive Design Orthographic Views (Scale 1:2)

The definitive design incorporates the results from user testing into the personal air purifier's design. The purifier can tilt on a stand which fits into the product's housing. The handle to the filter door was given a more exaggerated indent to communicate that it is supposed to be pulled. The purifier was given a simple form and lack of colour so that it does not stand out in the office environment. The power control slider is connected to an LED strip that brightens as the power is increased. The LED is also on a timer to turn red every four months, when the filter must be changed. To save space in the internal components, the voltage transformer was removed - the purifier would now have a cable where the transformer is in the plug that goes into the wall.

Internal Components (Scale 1:2)

1	Prefilter
2	Carbon Filter
3	HEPA filter
4	LED
5	Circuit board
6	Wires
7	Centrifugal Fan



Definitive Design

Narrative



This is Robert. He works in an office where he frequently switches desks. He is health-conscious, so he has a personal air purifier at work.



To set up his personal air purifier he must...



Adjust the angle



And change the filters every four months



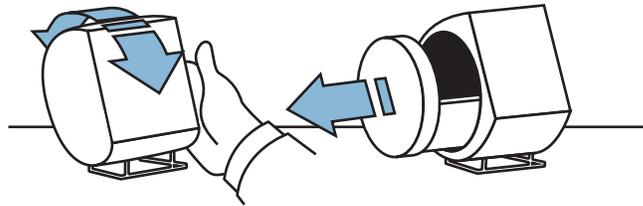
Adjust the fan's intensity



Now Robert can breathe the clean air he needs

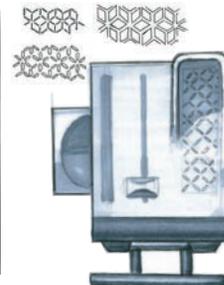
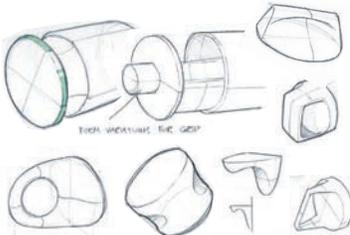
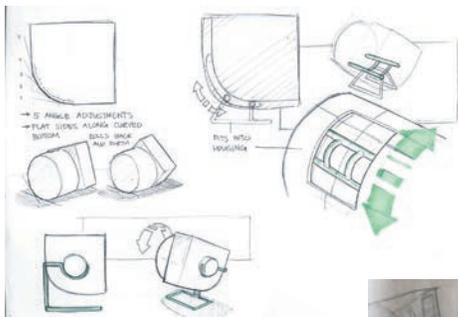
Key Operations to Test

- Adjusting the angle
- Changing the filters



Process Sketches

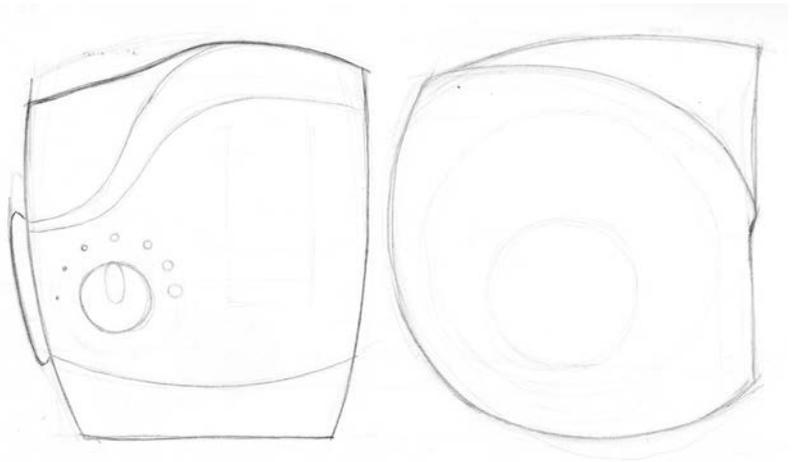
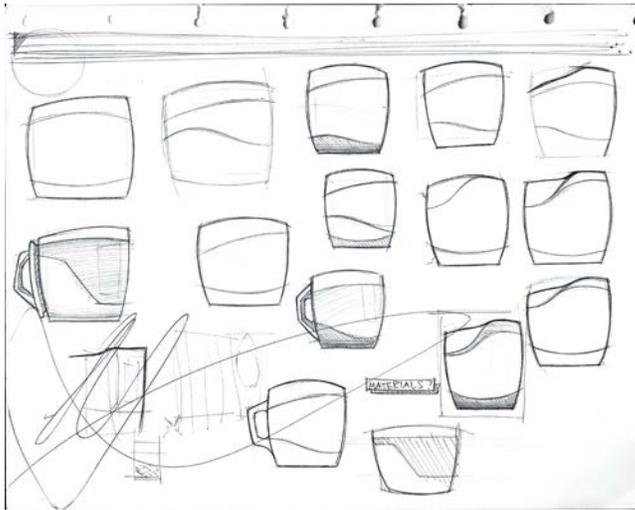
Eduardo Soto-Daneseo
IDES3310
November 18, 2019
Stephen Field



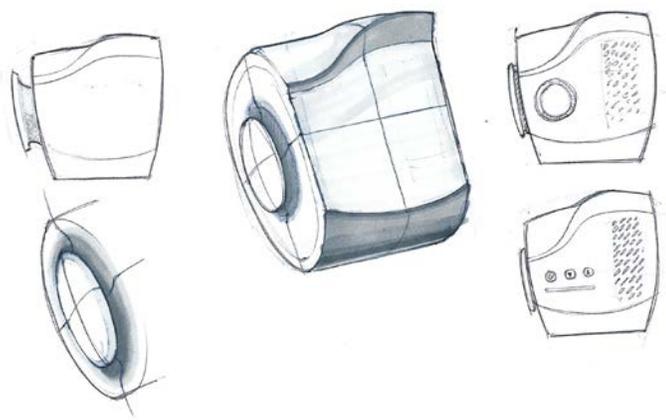
Other Boards from Definitive Design Stage

The proposed design received a lot of criticism. The overall form, grill pattern, power slider, filter cartridge handle, and stand were all unsatisfactory to the professor. This meant that almost every element of the purifier needed to be improved before the final model could be made. This was a frustrating, but valuable learning experience.

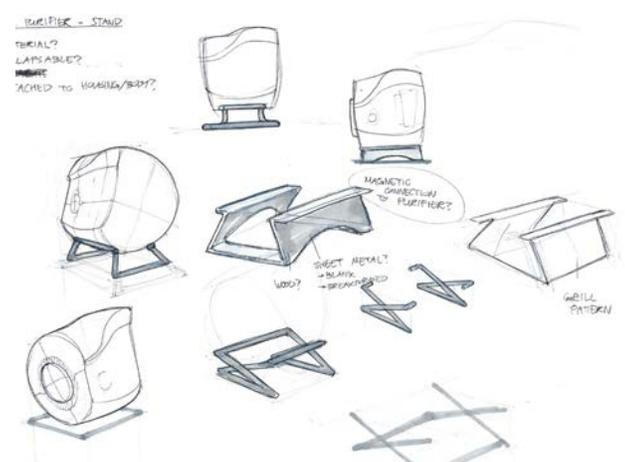
Changes Made



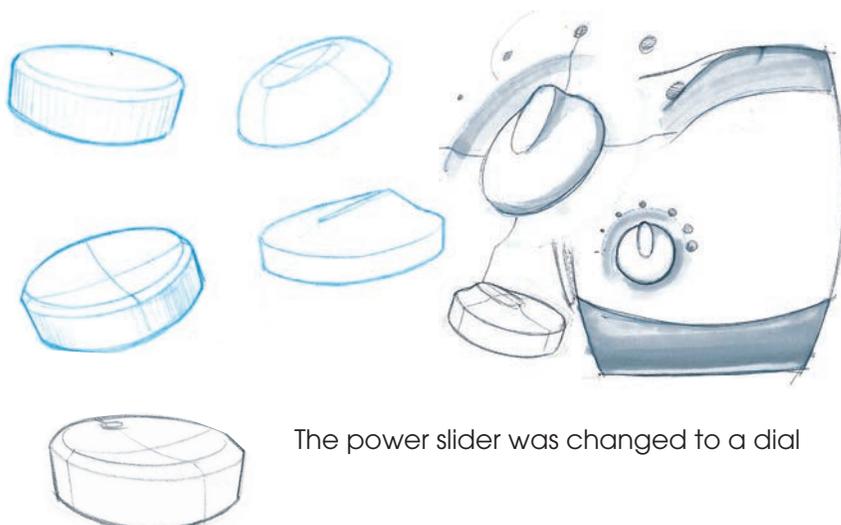
The overall form was changed to better communicate how air flows through the product.



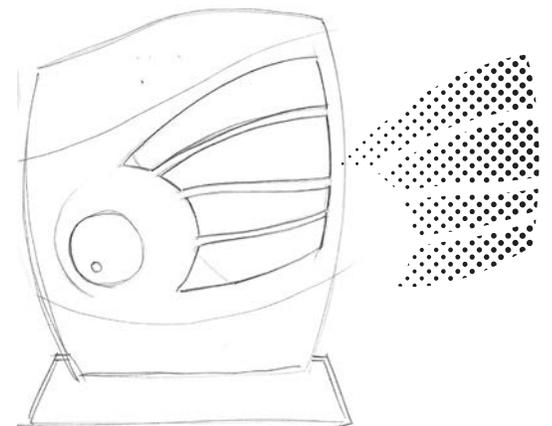
The filter door was made more sculptural, with a protruding grip with overhanging edges



The stand was changed to be made from sheet material instead of rods.



The power slider was changed to a dial

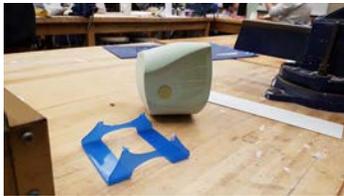


A custom grill pattern was developed

Construction of Final Model



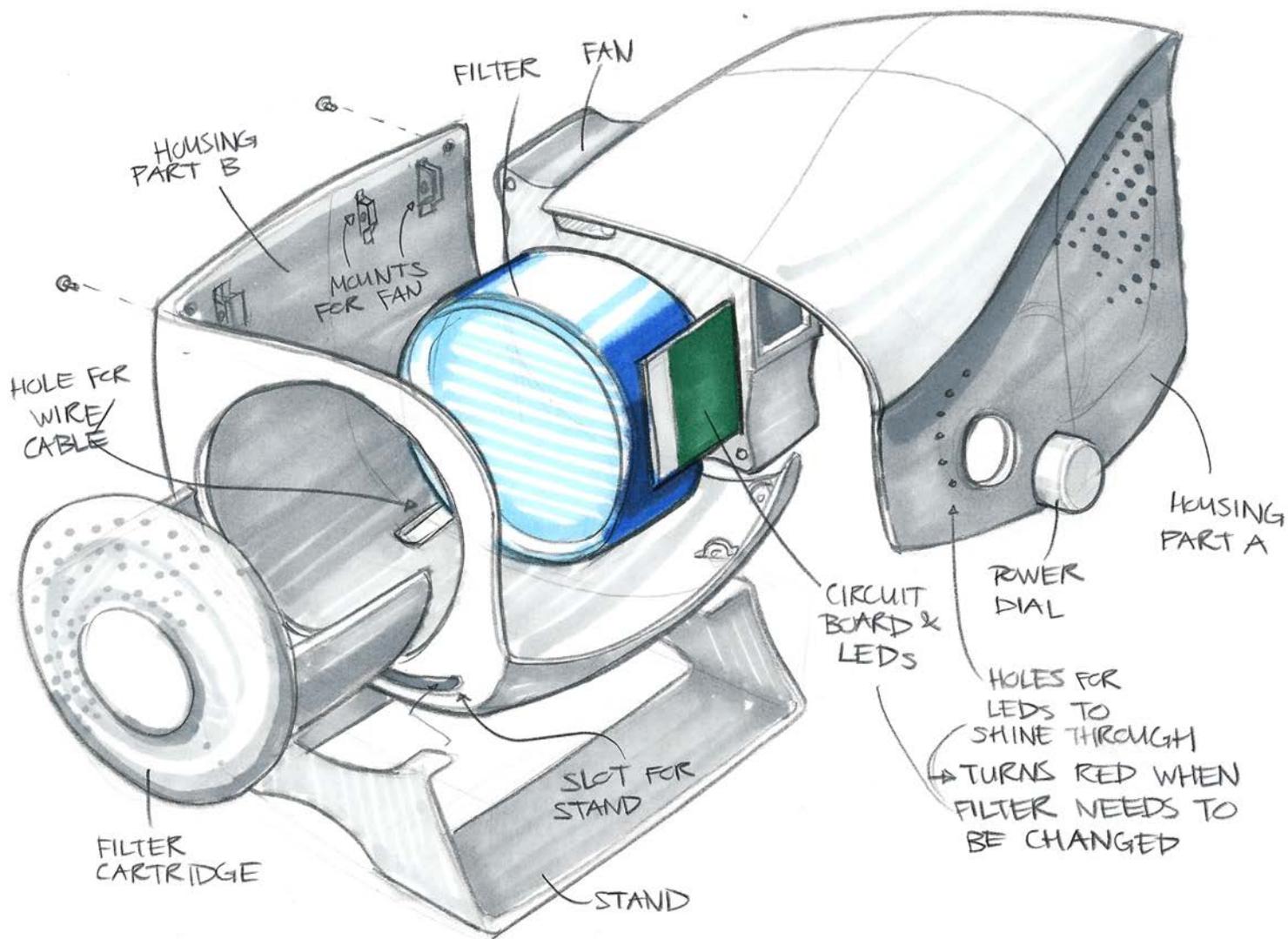
The main body was carved out of polyurethane foam. Large initial cuts were made with a band saw to get the basic shape of the purifier. The rest of the form was carved out by hand. The grill pattern was etched using a laser cutter.



The stand was made from acrylic that was laser cut and then thermoformed using a fixture and a strip heater. Next, the main body and the stand were painted. The power dial and filter door were 3-D printed using an SLA resin bath printer. The 3-D printed parts were then painted as well. Once all parts were dry, they were glued together and that concluded the model making process.

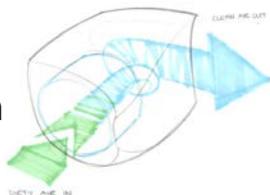


Final Design

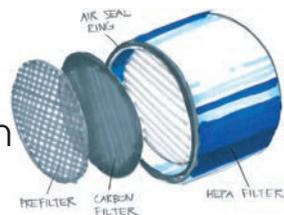


Final Model

Air Flow Diagram



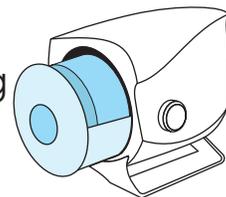
Filter System



Angle Adjustment



Changing Filters



**This product will be made fro produced in multiple colours

Conclusion

This project proved to be both extremely challenging and extremely rewarding. It was the most thorough project I've done. I learned a lot from considering all aspects of the design process. The research phase showed me the value of studying existing markets and technologies, as well as understanding a product inside and out - both of these things helped identify opportunities for innovation. Understanding and establishing the product's materials, internal components, and assembly were valuable learning experiences in product design. This was also the first time I got to do such in depth user testing. Seeing people interact with my models showed me flaws that I wouldn't have seen on my own. I gained valuable skills in both low and high fidelity model making this semester, I also really enjoyed using 3-D printing to make models. I wish that I could have had another day to repaint my final model, but I'm still very proud of the work I have done this semester.

In this project I changed my design to cater to the client's (professor) taste. I agree that my definitive design left a lot to be desired, but I still think that the changes I made were not what I wanted to do. This was good practice for designing for a client in the real world. I am in no way saying that I produced a bad design in this project, in fact I think I did a very good job and I am proud of the work I have done. This experience has helped me realize that I value my own creativity in my work. In future student work, I would like to take the opportunity to follow my own inspiration.