
Mini-Vac Full Slide Package

By Max Wertheimer

Define and Explore

Slide Summary

Max Wertheimer 9.17.20

Problem Definition: Mini Desk Vacuum Cleaner

Primary Functionality:

- Can suck up dust and particulates
- Large storage tank
- Plug in or battery powered
- Made from found materials

Secondary Functionality:

- Easy to clean
- Removable tank
- Compact
- Tube Nozzle
- Changeable nozzles for different applications

Thoughts:

- Would be useful
 - Making the blade could be complicated and hard depending on material
 - It can be made with a lot of varying materials
 - How could I make a nozzle?
-

Tube Neck Vs. Hard Neck

Functionality

The nozzle allows for me to be able to reach around into tight places easily

Pros

Able to reach around

More flexibility

Cons

Less suction power due to distance



Functionality

A rigid nozzle maximising power and simplicity

Pros

Easy to make

Higher suck power

Cons

Harder to get into tight spots

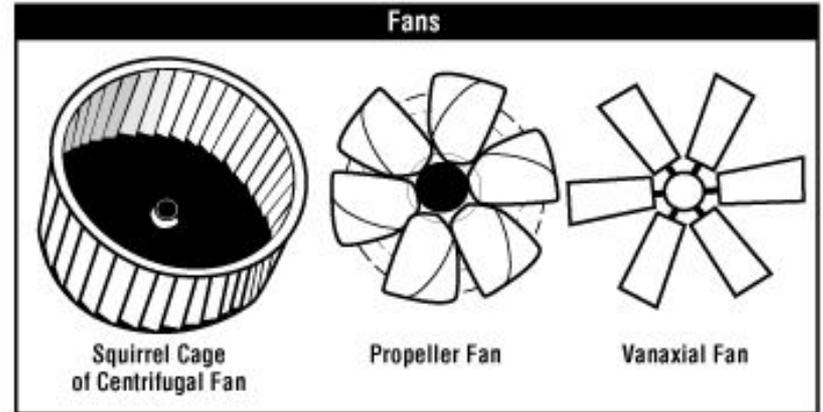


Fan Styles

I have 3 types of fans

Tubeaxial and vaneaxial fans are essentially propeller fans made to fit in a duct. They are usually limited to "clean air" applications such as exhaust ducts going through the roof. They are easier to make

The fans in your home furnace, vacuum cleaner and hair dryer are examples of centrifugal fans. They can operate against a high resistance and are typically used in local exhaust ventilation systems. The rugged radial blade centrifugal fans are the best type for exhausting heavy amounts of dust because they are less likely to become clogged or abraded by the dust. Hard to make



<https://www.ccohs.ca/osh/answers/prevention/ventilation/fans.html>

Container Size

Smaller Container

Functionality

A smaller container would be lighter and easier to transport

Pros

Easier to move and store

More power due to less volume that needs suction force

Cons

Cannot hold much



Larger Container

Functionality

Large container to hold more

Pros

Can store a lot

Easier to make

Cons

Harder to get into tight spots

Less suction force

Filter Types

There are many kinds of filters I can use.

They range from there inherent permeability.

My first idea was to poke holes in paper but that would prove to be timely and ineffective.

My next idea is a cotton mesh which could work but may require me to switch out every once and awhile

Lastly I thought of using a polyester mesh which would be stronger but more porous



Takeaway Summary

- Couldn't find any substitutes of a vacuum cleaner
 - Going with my original Idea
 - I have a lot of variety when I am making my vacuum cleaner
 - Some of these may not be possible due to material constraints
 - I think that durability is something that I will need to work on
-

Define and Explore

Slide Summary

Max Wertheimer 9.17.20

Problem Definition: Mini Desk Vacuum Cleaner

Primary Functionality:

- Can suck up dust and particulates
- Large storage tank
- Plug in or battery powered
- Made from found materials

Secondary Functionality:

- Easy to clean
- Removable tank
- Compact
- Tube Nozzle
- Changeable nozzles for different applications

Thoughts:

- Would be useful
 - Making the blade could be complicated and hard depending on material
 - It can be made with a lot of varying materials
 - How could I make a nozzle?
-

Tube Neck Vs. Hard Neck

Functionality

The nozzle
reach around

able to
reach easily

A rigid neck
maximising power and
simplicity

Pros

Able to reach

More flexibility

Cons

Less suction power due to distance



Functionality

Pros

Easy to make

Higher suck power

Cons

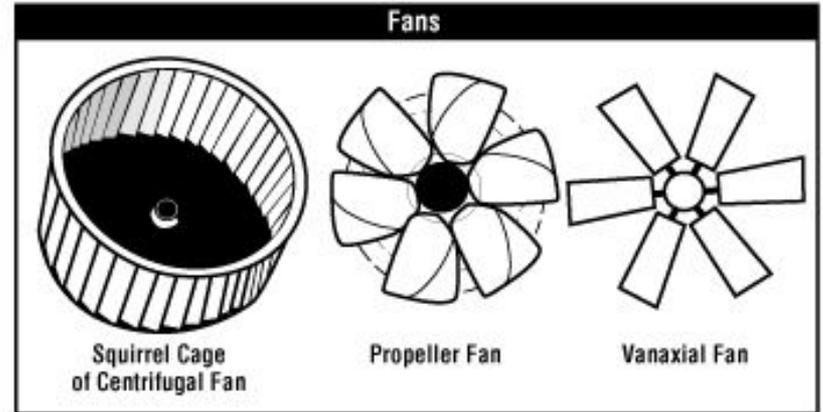
Harder to get into tight spots

Fan Styles

I have 3 types of fans

Tubeaxial and vaneaxial fans are essentially propeller fans made to fit in a duct. They are usually limited to "clean air" applications such as exhaust ducts going through the roof. They are easier to make

The fans in your home furnace, vacuum cleaner and hair dryer are examples of centrifugal fans. They can operate against a high resistance and are typically used in local exhaust ventilation systems. The rugged radial blade centrifugal fans are the best type for exhausting heavy amounts of dust because they are less likely to become clogged or abraded by the dust. Hard to make



<https://www.ccohs.ca/osh/answers/prevention/ventilation/fans.html>

Container

Smaller Container

Functionality

A smaller container would be lighter and easier to transport.

Pros

Easier to move around.

More power due to needs suction force.

Cons

Cannot hold much.



Larger Container

Functionality

Large container to hold more.

Pros

Can store a lot.

Easier to make.

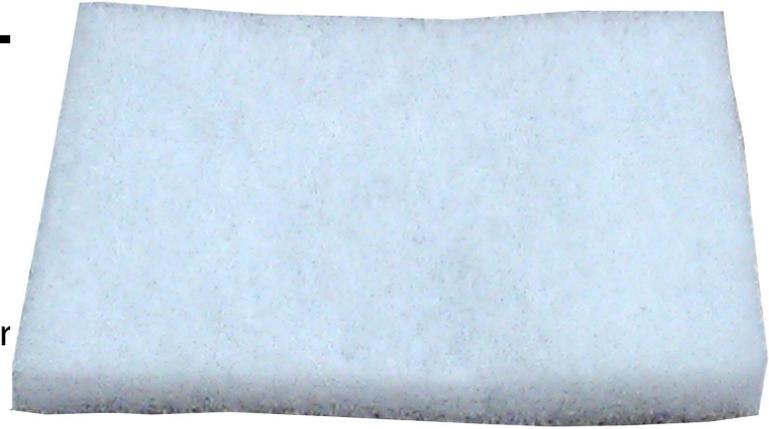
Cons

Harder to get into tight spots.

Less suction force.

Filter Types

There are many kinds of filter use.



They range from there in permeability.



My first idea was to poke paper but that would prove timely and ineffective.

My next idea is a cotton mesh which could work but may require me to switch out every once and awhile



Lastly I thought of using a polyester

Takeaway Summary

- Couldn't find any substitutes of a vacuum cleaner
 - Going with my original Idea
 - I have a lot of variety when I am making my vacuum cleaner
 - Some of these may not be possible due to material constraints
 - I think that durability is something that I will need to work on
-

Constraints and Key Features

The Mini Vac

Primary Functions

1. Capable of sucking up particulates
2. Stores dust and particulates in storage container
3. Made of improvised and found material
4. Not fall apart upon turning on
5. Easy to maneuver

Constraints

Size: Handheld and can be easily store under desk.

Units Supported: It needs to be able to hold at least 500 cubic centimeters of space for dust.
Doesn't need sotarge.

Weight: This is not a constraint for me, the materials I will be working with will be light. But I hope it to be light.

Materials: I don't have much and will need to adapt for a filter, fan blade, and nozzle.

Key Feature #1 Handle

For maneuverability and ease of use I plan on adding a handle to the top of it which can pivot at the base and be used as a point of rotation for the vacuum cleaner much like a bucket handle. This will make it easy to pick up and move around.



Key Feature #2 Container

I plan to use a water bottle or liter bottle to act as a counter for the bust and motor. It also has a nozzle built in which will allow me to add custom nozzles via bottle cap. The shape also maximises power due to the diminishing top part.

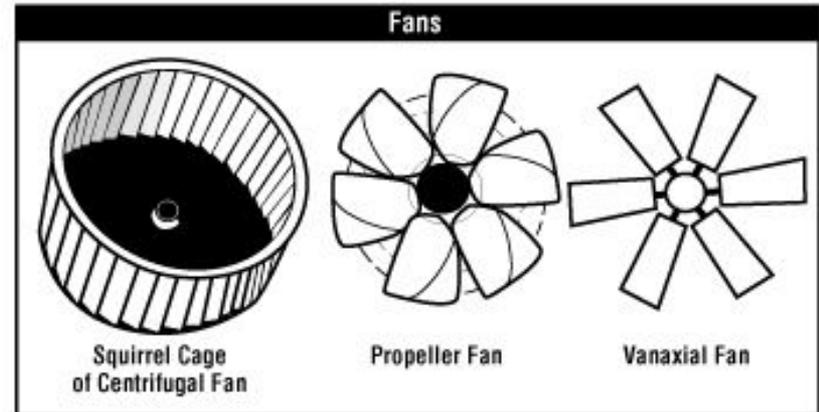
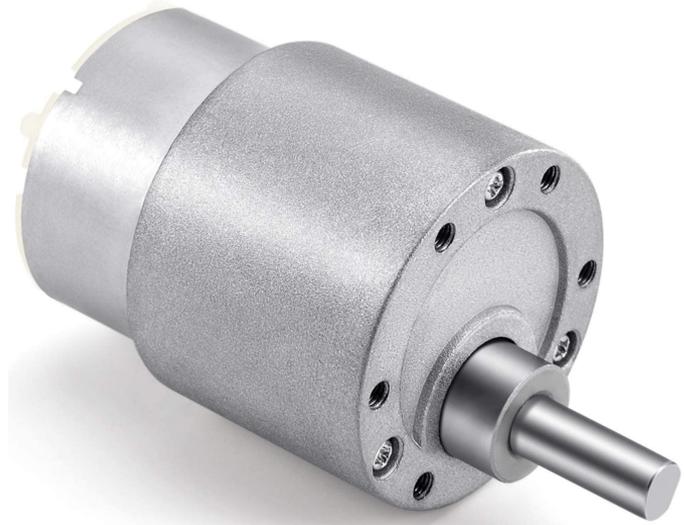


Particulates and dust here



Key Feature #3 Motor and Blade

One of the more difficult parts will be the motor and blade. This will sit at the end of water bottle and is responsible for the suction power of vacuum. The blade's material will be made from aluminum and will be an undetermined shape. Powering the motor is my biggest concern.

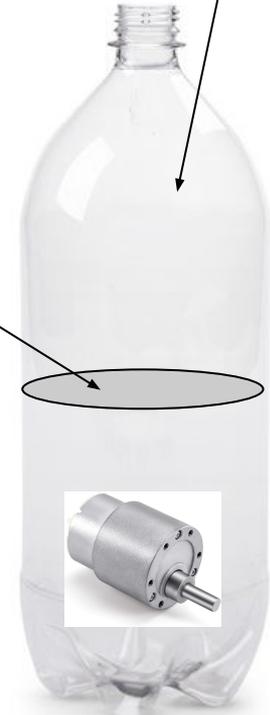


Key Feature #4 Filter

This is one of less planned out bits. The filter will be placed in the middle of the container and is used to put between the blade and the nozzle to act as an air permeable barrier so the dust doesn't hit the fan and build up. This will make the container easy to empty. The main issue is that I don't know what material to use as a filter. I could also use two filters, a fine one for dust and a course one for particulates.



Dust goes here

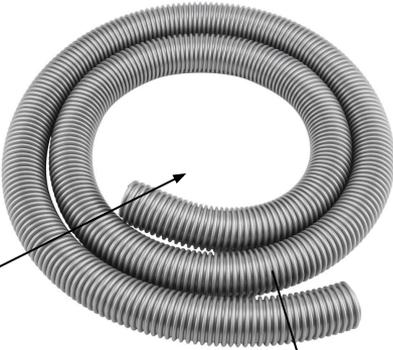


Key Feature #5 Nozzle

The nozzle is another component that I have thought out but don't know what material to use. The nozzle going to be affixed to a tube as to give maneuverability to vacuum. I may add other nozzles, perhaps one with a brush nozzle to get into fabrics and a thin hard tip one to get into deep crevasses and crevices. I am thinking of attaching the nozzle to a bottle cap to easily attach and detach from the bottle



The Final Idea



Dust goes into container

Dust gets sucked into nozzle

Blade creates suction force



Dust hits filter and then stays there

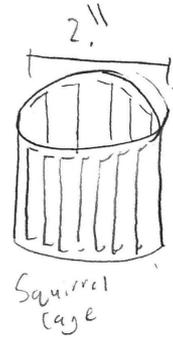
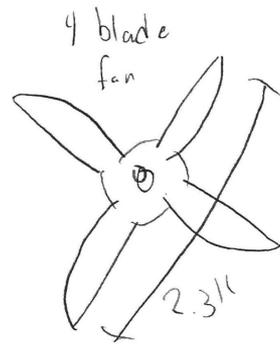
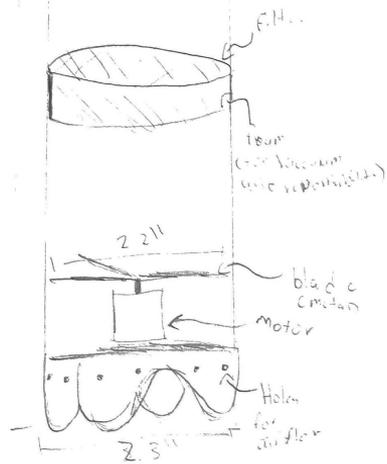


Design #1
Thin Version

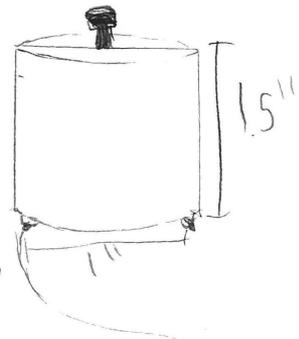


Objective: Suck up dust and particulates
 Approach: mini VAC
 Material: bottle, motor, aluminum, plastic

2.25"



Objective: create a suction force
 Approach: A motor with a fan
 Material: Motor, 9V battery, aluminum

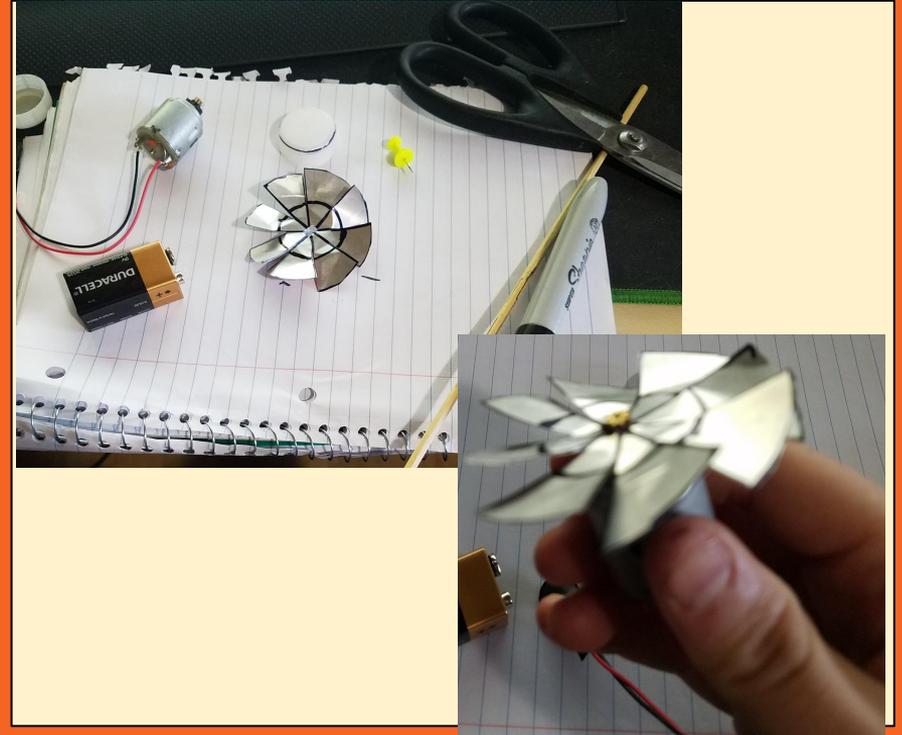


Phase 1 Prototype Build

I learned how to create scrap metal and then how to measure and build two different types of fans. I also learned that I may need bigger container so I can have a bigger fan and also I need a stronger motor.

I liked testing out eh different strengths of the blade

Not put my knuckle near the blade as it is spinning



Phase 1 Prototype Test

What is the purpose of the prototype

- To test the strength and torque of my fan and see which size is best

How did you test your prototype (User Testing, Simulated Test, and/or Visual Evaluation)

- I tested them through two assays. The first was through visualizing seeing the speed of each size
- The other was attaching a piece of paper to string and see how much each fan pushed the paper from varying distances.

Results

- The smaller blade was more powerful and produced more torque, however, the large blade is stronger up close but dropped off significantly.
-

Phase 1 Prototype Evaluation

What aspects of your design and/or build do you like?

- My technique for making the blade. I cut up and hammered cans for sheet metal than used a bottle cap and scissor to mount onto the motor



What aspects of your design and/or build do you not like?

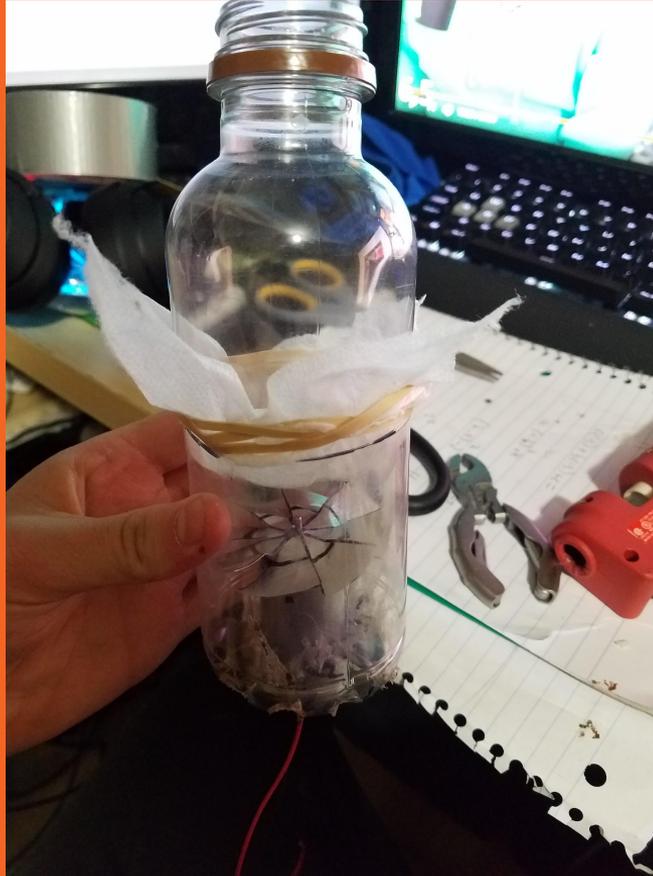
- The biggest flaw is the apparent lack of strength. This may change once it is put into a bottle and perhaps it can focus the suction power
- It also is difficult to mount onto the motor and taking it on and off constantly has worn down the center of the blades making it not fit

How are you going to improve your design?

- The biggest issue is strength I plan to get another motor and to remake the blades so that they are fresh. I also need to try putting the blades into the container to see how it acts in a vacuum. I am also going to try and use different mounts for the blades onto the motors.



The Mini-Vac Version 1



Rough Draft Build

Something I learned was

- Just about anything can work as a material and while measurements are very important improvising also works
- Tension is a very strong force and I use it to hold the blade on the motor and the motor to the bottle

Something I like was

- I like how my prototype turned out. I managed to actually make it which is a feat as I am not that great a builder.
- I also was able to repurpose a layer of a disposable mask as the filter which I think was intuitive and solved the long standing issue of who to make a filter

Something I will not do again

- I need to use a drill the next time that I am boring holes into the bottom for airflow. I had used a Hot glue gun that had broken and just used the metal tip to burn the plastic but it took far longer than it should of. I also need to devise an easier method of taking the blade out to alter or change it



Rough Draft Test

The key features my Rough Draft addressed were

- The vacuum's power. Also the seal or any holes that may affect the power of my vacuum cleaner

To test my Rough Draft I did a (User Testing, Simulated Test, and/or Visual Evaluation)

- I used the same trick that I did with my motor and just put the vacuum up to a piece of paper on a string to see how strong the power is.

Results

- The good news is that there is power and that it does indeed suck. The issue is that I need to increase that power. My ideas are to change the blade and make a seal around the middle.
-



Rough Draft Evaluation

What aspects of your design and/or build do you like?

- I really like how it turned out and how it actually works. That was one of the things that I mainly worried about. The process was smooth and I was able to think of a lot of ways to solve my issues.

What aspects of your design and/or build do you not like?

- I do not like how difficult it is to get the blade out and change it. It is also difficult to attach it to the battery and then use the vacuum. The last thing I need to make a neck so that I can just move the neck rather than the entire thing. I also need a better seal on the vacuum as I think that is an issue affecting the power

How are you going to improve your design?

- I need to find out how to make a switch and then make a seal. I also am going to try different blades or test with the pitch of the blade. I also need to add a neck.



Final Iteration

Iteration 1 - *Airflow*

I chose to focus on this area because

- I believe that my vacuum that comes apart at the middle is an issue. I believe that this is creating small gaps where I am losing that airflow. Another issue is that I don't have enough holes at the bottom for the air to flow out efficiently

My approach

- I ended up cutting large flaps on the side of the bottle and burning holes in between the flaps to increase the area beneath. I also ended up using duct tape and putting it over the rubber bands that held the filter.

The results

- It all worked perfectly. After doing this I could feel a much greater force coming out the back and the vacuum was able to pick up small pieces of plastic and keep going.



First Draft Final Draft

Iteration 2 - Fan *Blades*

I chose to focus on this area because

- I never got to toy with it as much as I would of liked to. I think that if I toy with this I make a blade that is much more efficient and produce more airflow

My approach

- I ended up twisting the blades at different angles until I found the optimal angle

The results

- After testing a few different angles of the blades i found that it needed to be much steeper. I tested by just feeling the airflow and using the paper and string method



Iteration 3 - *The switch*

I chose to focus on this area because

- I found out that I need to make a switch. I can't have the vacuum run for too long or it can burn out but it is hard to keep attaching and detaching the battery.

My approach

- I attempted to use the switches that was given to me as well as look for switches I could salvage off of other devices

The results

- I couldn't get the diy switch to work and then I remembered that I had the remote control for the rc car full of knobs and buttons. After ripping it apart I found a small button and put it in the circuit and it surprisingly worked! Now when i hold down the button it goes!



Project Functionalities

Primary Functionalities

Can suck up dust and particulates

- This was the primary objective of my project and I am happy to say that my vacuum works on dust and particulates storing them in the tank.

Large storage tank

- This is relative. I believe that I have a sufficiently sized tank that can hold as much as I need it to as it will live on my desk.

Plug in or battery powered

- Not only did I get it battery operated I also managed to put a button in the circuit and I can keep the battery plugged in and just hold the button down to activate the vacuum



Secondary Functionalities

Removable tank

- I achieved this in a way. While I can remove the tank it takes some efforts to put it back on as I have to reapply the tape acting as the suction between the two section.

Compact

- It is compact. I taped the battery to the side and the used a smaller bottle than I intended to and it is easier to use.

Easy to clean

- I am able to take off the cap which is what the tube is attached to. This makes it easy to clean as I can just turn it upside down over the trash can.

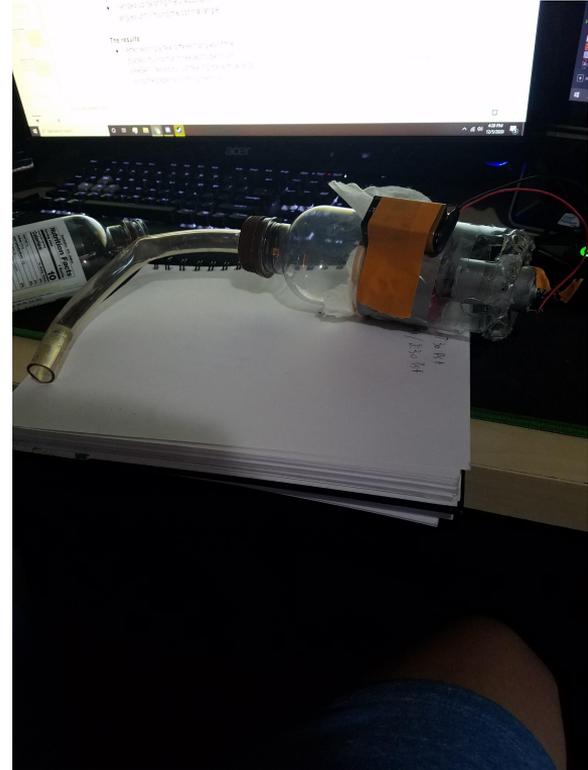


Concluding Thought

First Draft



Final Draft



Project Reflection

Aspects of my project that I like

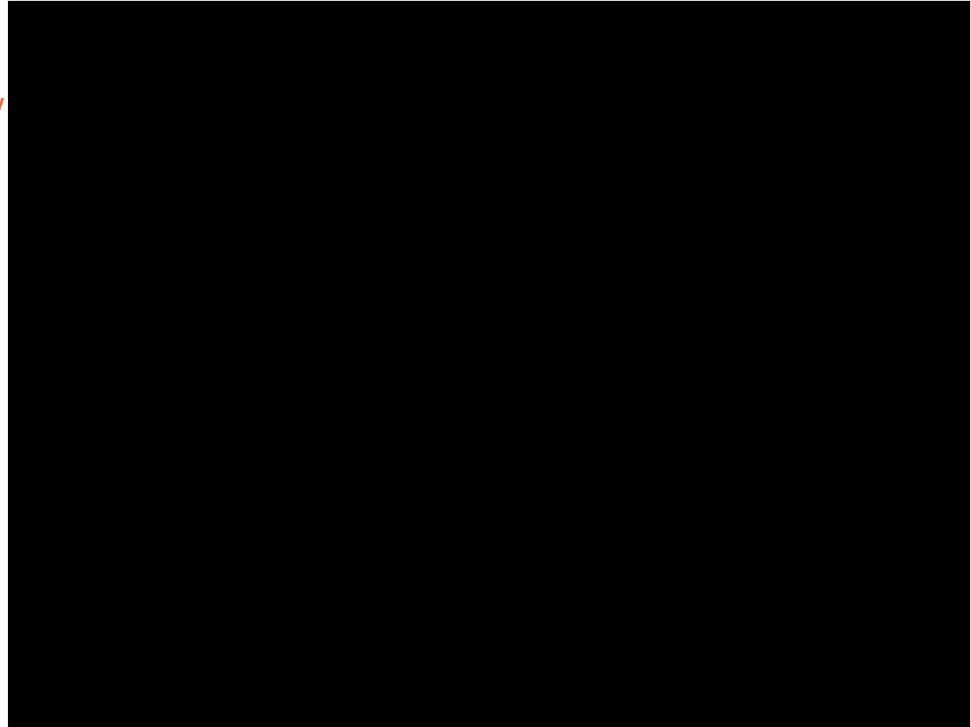
- The main thing that I liked was that it actually worked and satisfied all of my requirements. I also enjoyed how i was able to install a button that activates the vacuum while I hold it.

Aspects of my project that were difficult

- The more difficult aspect of the project was getting the fan to work and actually creating a suction force. It took a long time to fix and I had to work with making scrap metal and molding it which was difficult.

What I would do differently next time

- The most major thing I would change is the aesthetics of my project. While it is functional it doesn't look the nicest. I would want to focus on making it look nicer
-



—

Fin