Project 3

3D Design 1: Spatial Thinking & Materials

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Design Statement

The goal for this project was to create a mechanical form that would produce unique sounds while keeping a simple, yet a well-balanced design that incorporates different interactive elements. The mechanical form which we created mixes the contents inside the container in order to produce a wide range of unique sounds. It simply uses a switch, a potentiometer, and a servo motor in order to achieve this. We chose wood and acrylic as our main materials for our mechanical form, because the wood will provide a natural, yet simple finish, while acrylic will provide the form with a sophisticated and professional feel. Furthermore, in order to give the mechanical form a more unique look, 3D printing was used for certain parts of the form. By incorporating these different materials, the goal was to provide the user with a unique cognitive experience through touch, sound, and overall physical interaction with the form.

Visual Research - #1, Fan



https://www.nsauk.com/wp-content/uploads/2017/05/DF-2331W-9in-desk-fan.jpg

When our project first began we were intrigued by the idea of having a form that used wind to interact with objects and make sound. We considered having wind chimes reacting to a DC motor with a fan blade, as well as dangling objects that were being blown and knocked around inside of our shape.

Visual Research - #2, Wind Turbine



https://manifest.skydiving.com/wp-content/uploads/2017/04/indoor-skydiving-virginia-beach-1200x900.jpg

Similar to the our fan inspiration, we wanted our form to reflect something similar to a vertical wind tunnel used for skydiving. This is because originally, we were hoping to have objects blown around within the structure that could be seen from the outside.

Visual Research - #3, Blender



https://manifest.skydiving.com/wp-content/uploads/2017/04/indoor-skydiving-virginia-beach-1200x900.jpg

When we initially began our project we were interested in the idea of a moving blade at the bottom of a container that would mix objects around and create noise. The design influence of these devices is clear in our final product, which functions in a similar way except for being non-destructive.

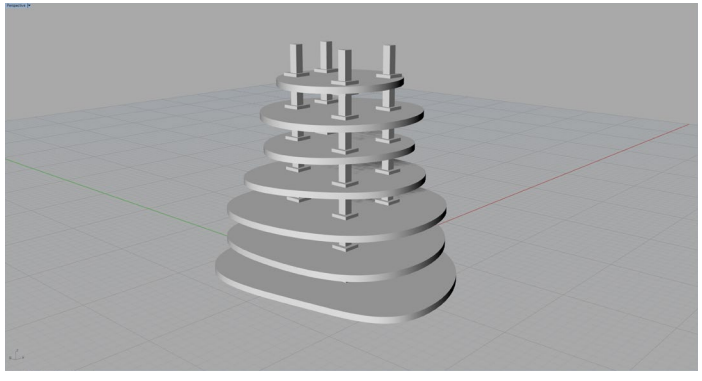
Visual Research - #4, Push Pop Toy



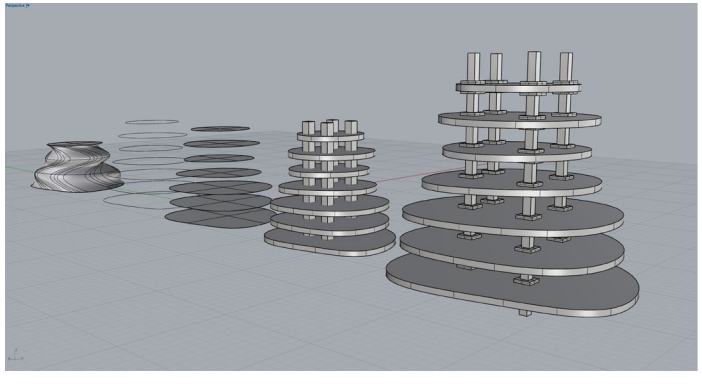
https://manifest.skydiving.com/wp-content/uploads/2017/04/indoor-skydiving-virginia-beach-1200x900.jpg

Once we had completed the designs and planning for our form, we had to make a decision on what objects to fill the form with in order to create sound. After testing different varieties of objects, we decided on using ping pong balls. This is because we found that when mixing together in the machine they not only interacted with one another but they also popped up and down creating visually interesting sudden movements along with the sound.

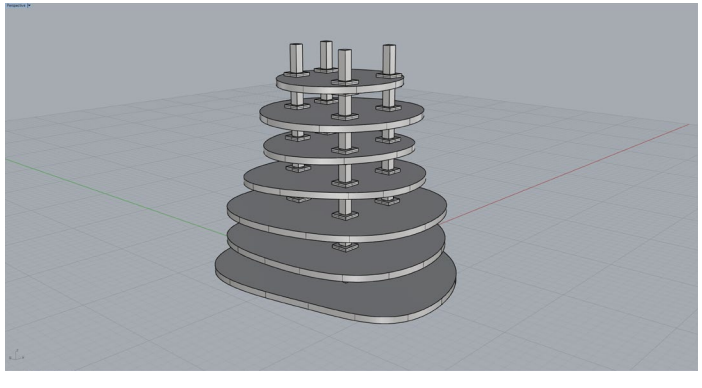
Form Exploration 1
3D Model (Rhino Mockup)



Rendered View

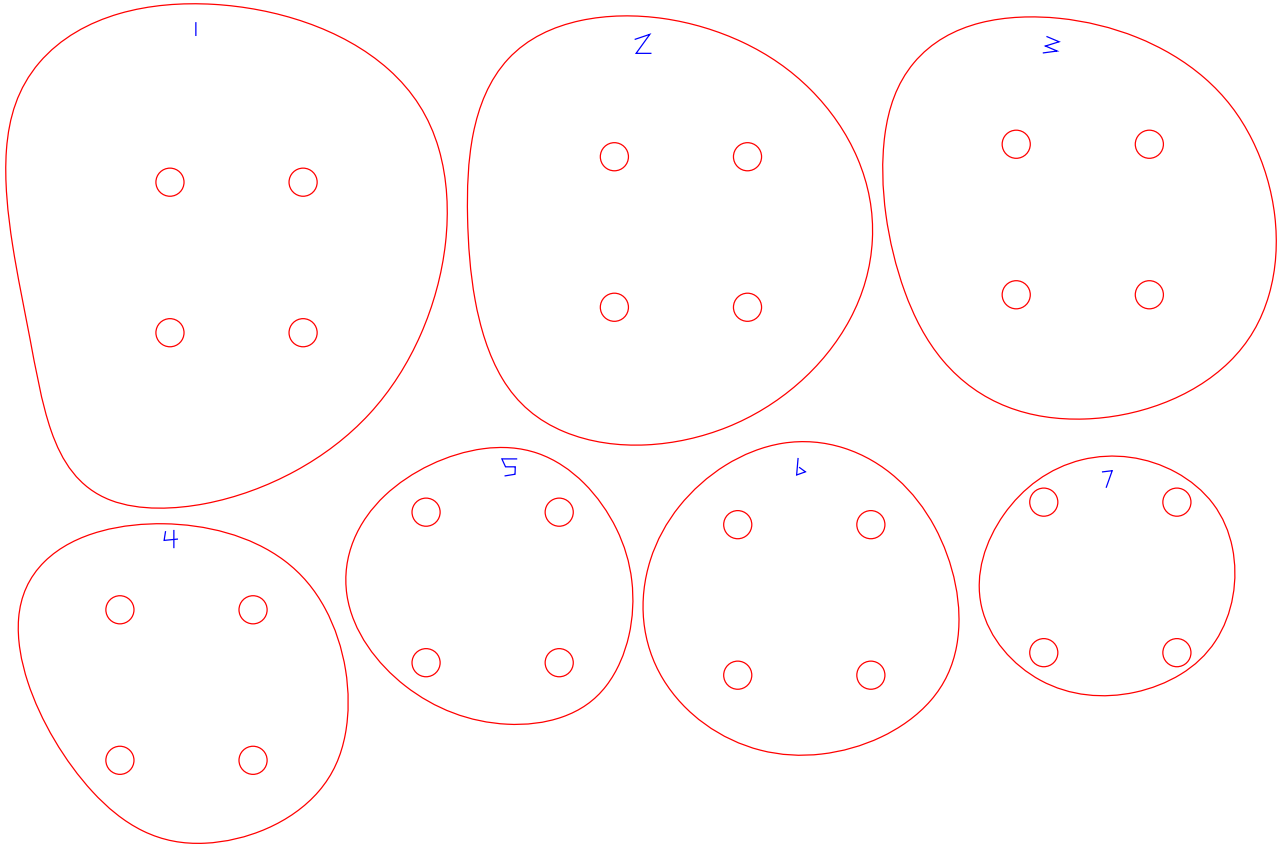


Progression



Shaded View

Form Exploration 1
Fabrication - Illustrator File

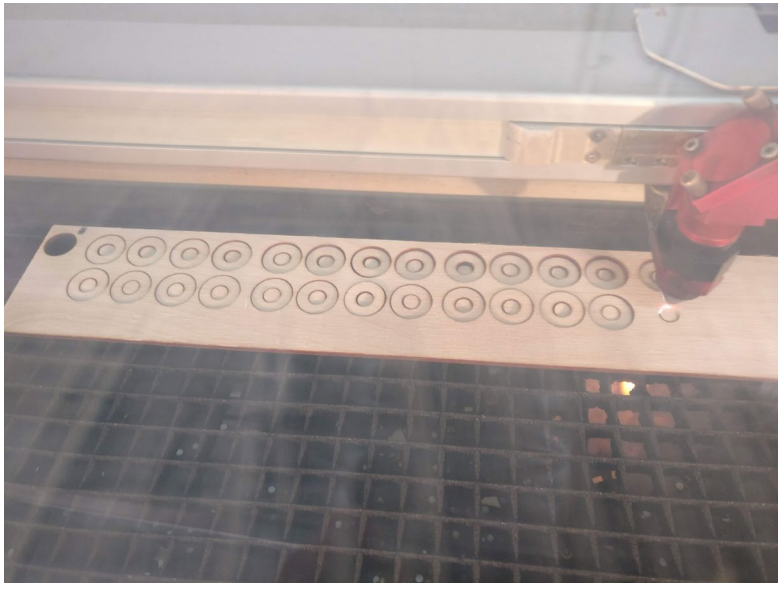


Organic tower structure

Form Exploration 1
Fabrication - Laser Cutting



Main Layers



Support washers to help hold the structure together

Form Exploration 1
Assembly



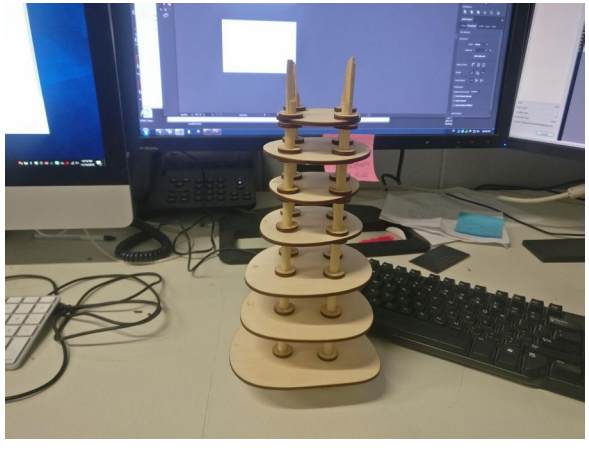
Lasercut objects



First layer



Several layers



Finished form

Form Exploration 1
Final Form



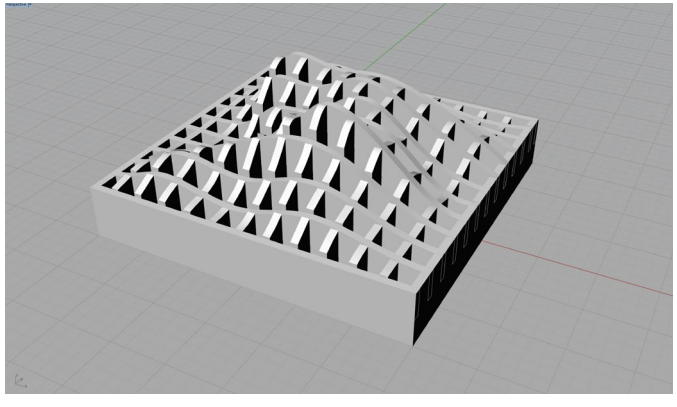
Front



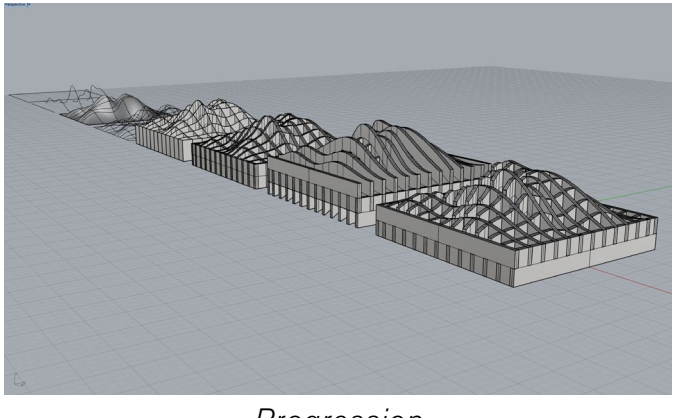
Back

In making this form, I wanted to explore the idea of incorporating these suspended sliced layers. Some of the concepts that went along with this design were conductive layers or buttons on each layer which each made a different noise, creating a sort of instrument. As well as potentially using servo motors to interact with the support poles and make noise by hitting against them, or having objects fall down each layer of the form. However in the end we decided to go in a different direction due to the limitations of this form, and what we were hoping to accomplish with the project.

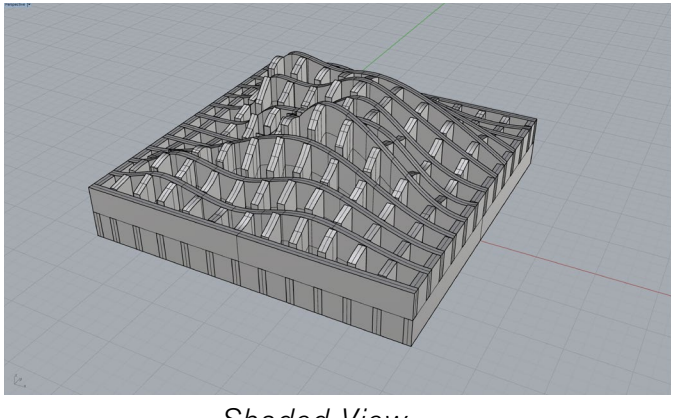
Form Exploration 2
3D Model (Rhino Mockup)



Rendered View

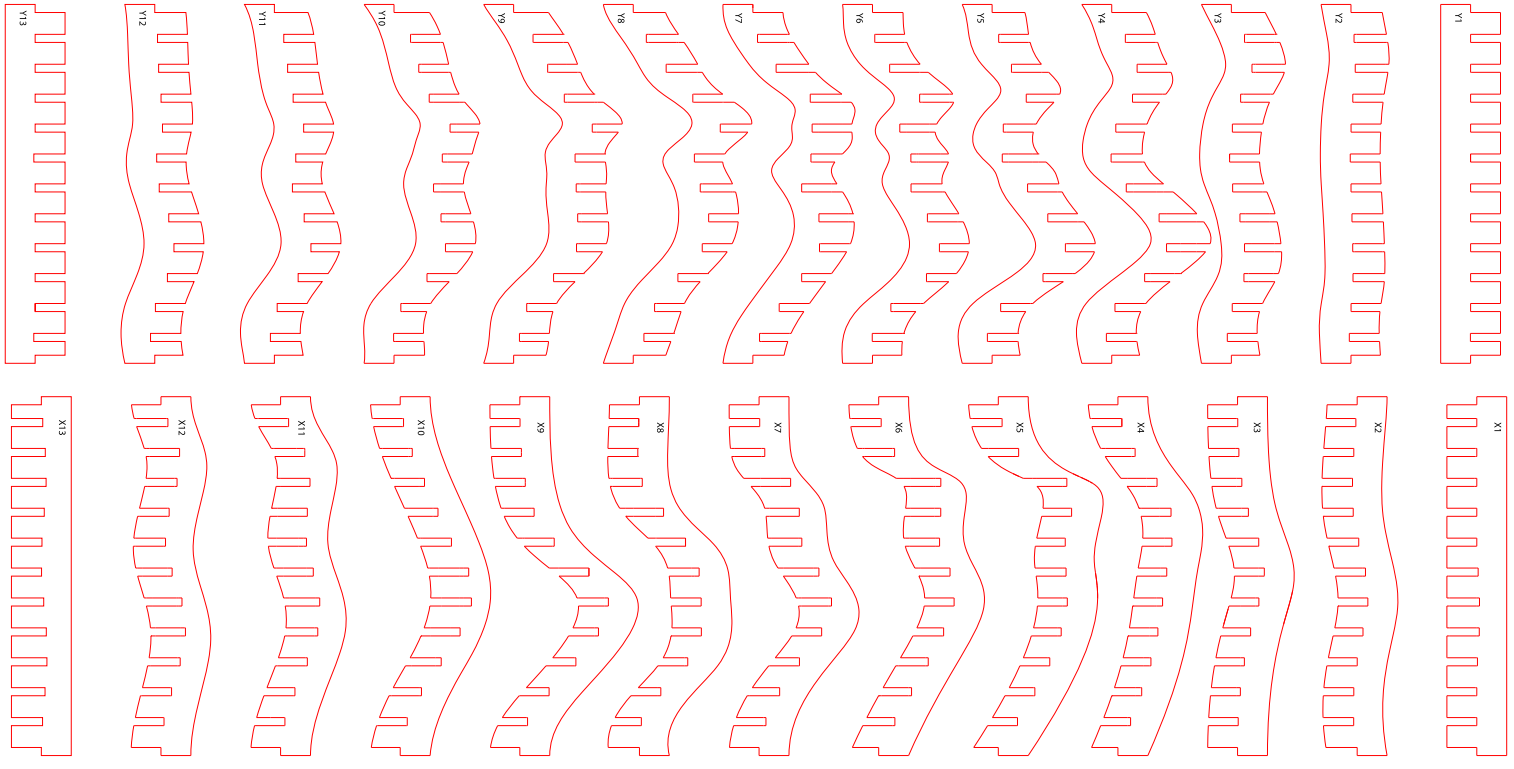


Progression



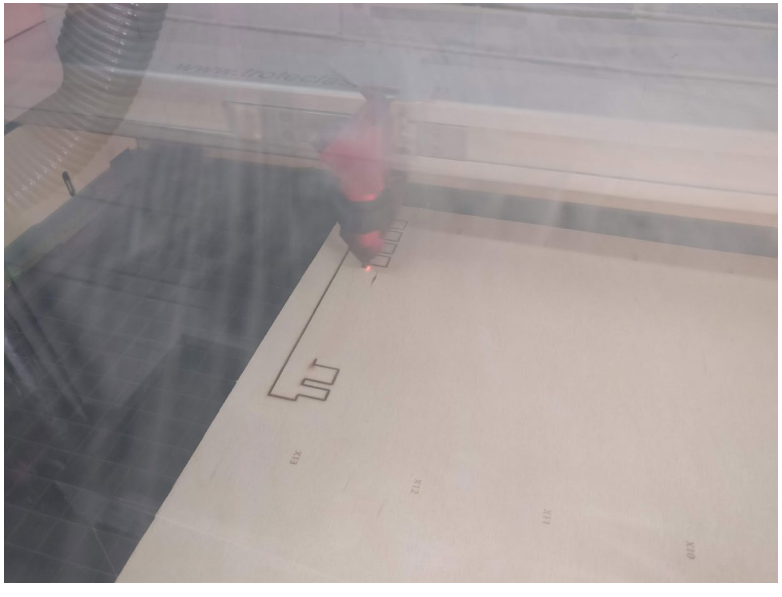
Shaded View

Form Exploration 2
Fabrication - Illustrator File

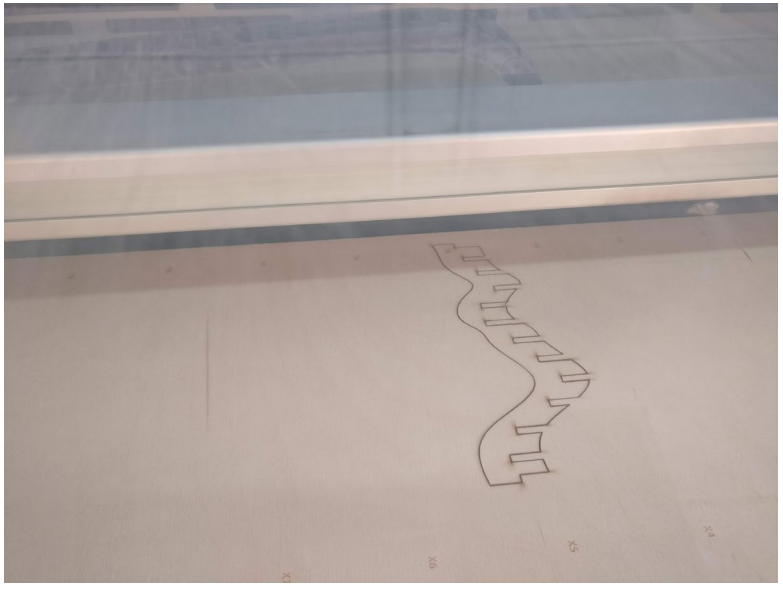


Simple waffle form, following the provided tutorials

Form Exploration 2
Fabrication - Laser Cutting

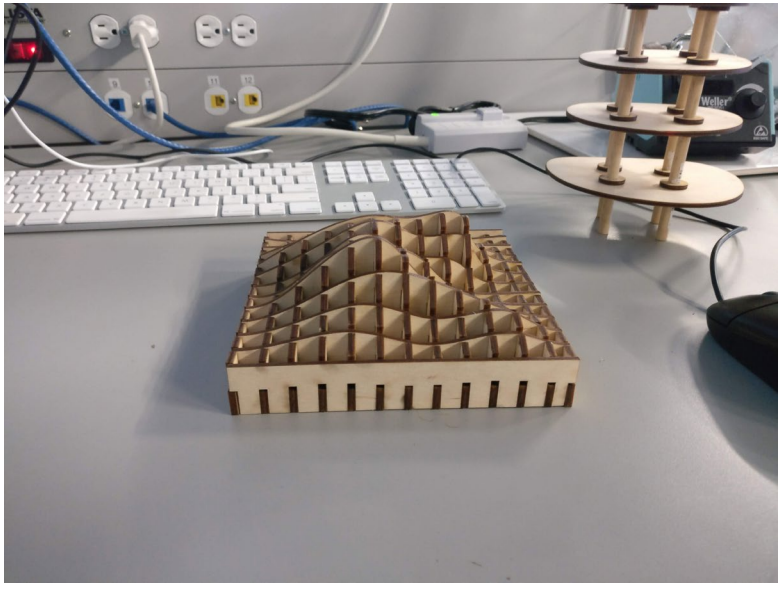


First Y-Axis object

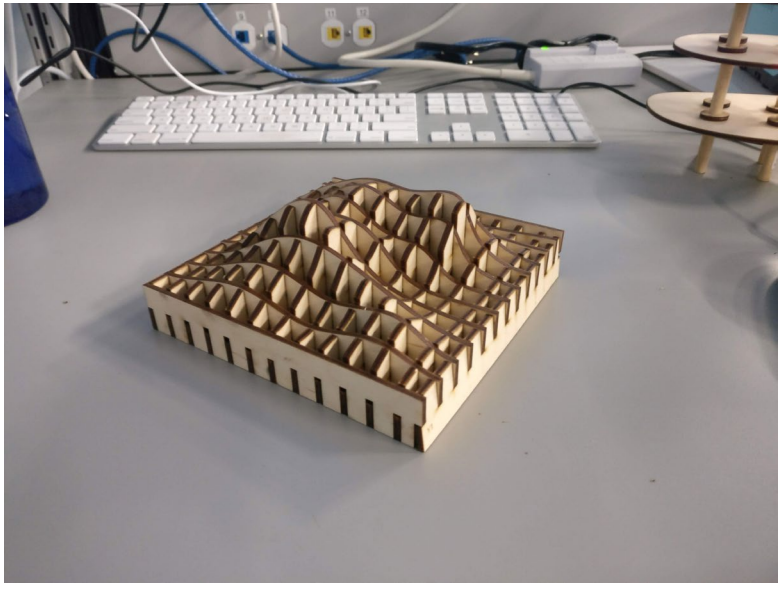


Y-Axis piece 5

Form Exploration 2
Assembly



Each piece slots together



No adhesives required

Form Exploration 2
Final Form



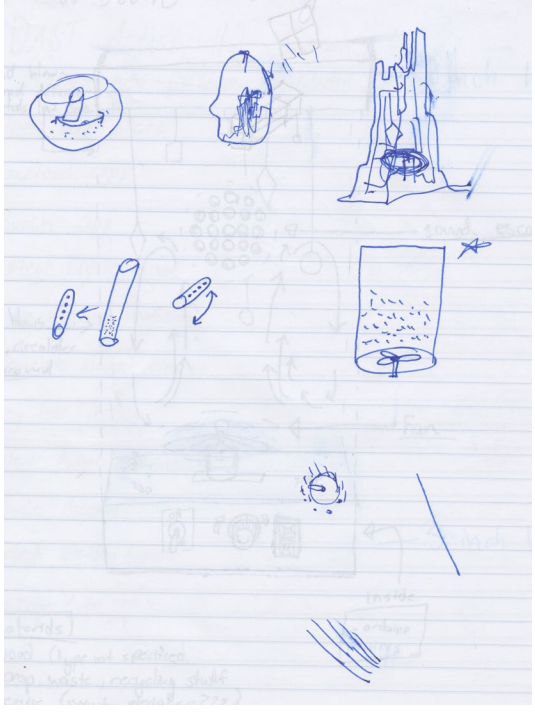
Front



Right

In making this form, I was hoping to become more comfortable with the idea of the wooden components fitting together in a waffle method. Even though it did not have much influence on the final design of our shape, it was very valuable to create because of what the assembly process taught me about the precise measurements required to fit pieces together. As well as, creating designs and mockups that were accurate to the thickness of the wood at our disposal, which was especially influential to tight construction we wanted out of our design.

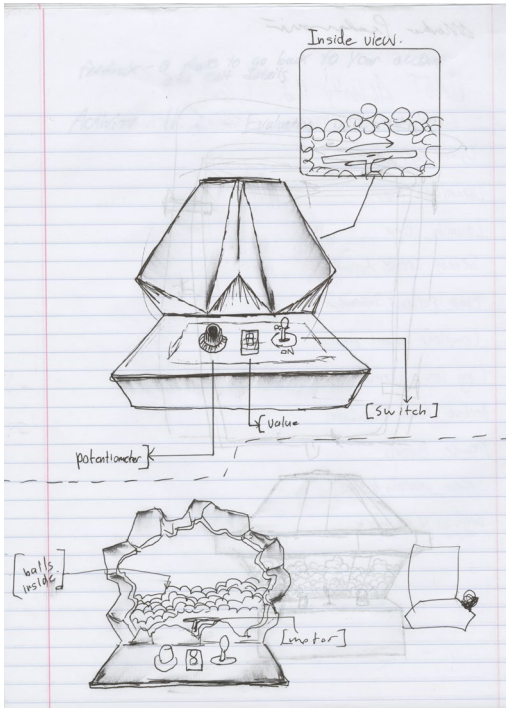
Final Form Process
Ideation



One of the main themes that we attempted to work from was the idea of using a motor to instigate the contact between objects and materials. Our original iteration of this idea was to have a fan blade powered by a DC motor blow upwards, like a vertical wind tunnel. From there it would either create noise by throwing objects around, or by the wind interacting with objects suspended from the ceiling of our object. Or alternatively, the container would use a servo motor to push and mix objects rather than blowing them around.

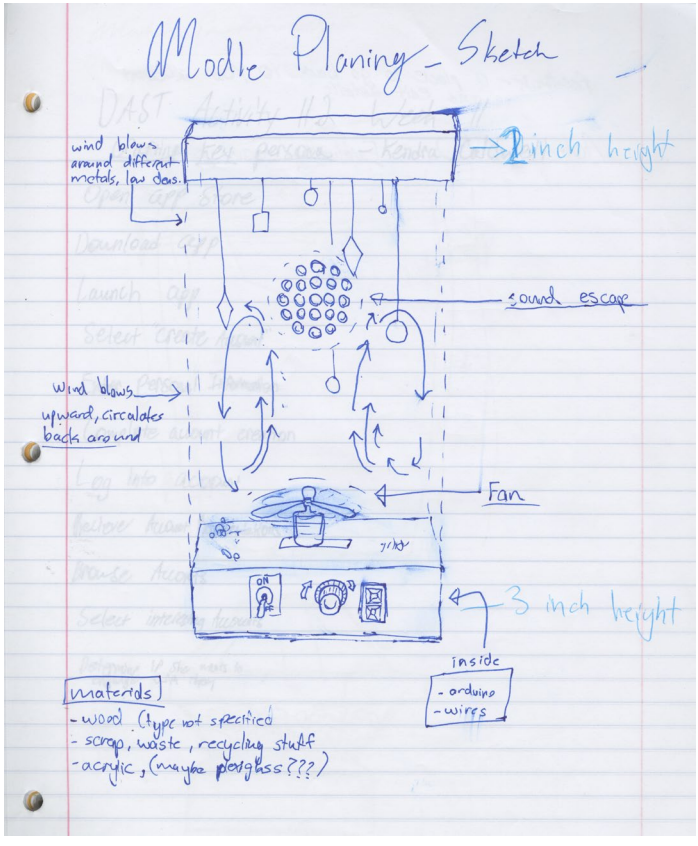


When designing the functionality of our object, we knew that that it was going to be centered around the idea of a transparent container, filled with objects, with a motor at the bottom. Some of our ideas included having the container rotate along with the objects it contained, or a sealed design vs. a design that could be accessed to exchange the objects and materials inside the container. As well as the decision between a functionality designed around a fan blowing materials, or a servo motor that pushed and blended objects.



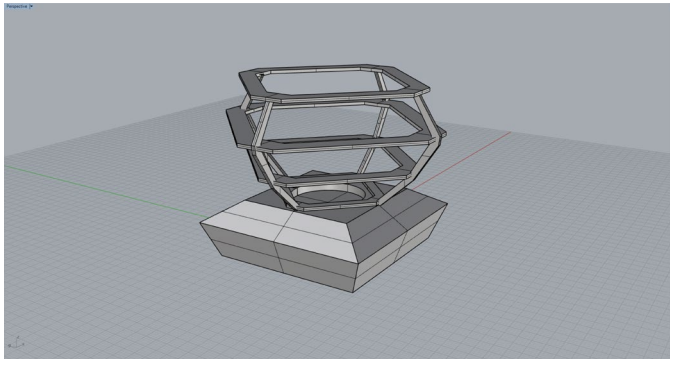
In designing the form, we knew that the object had to be focused around an acrylic container which would allow users to see the objects interacting with one another. Around this time, we also decided on 3D printing a faceplate for the front of the model that would house all the components that users would need to access. In the initial planning phases, our ideas were expressed in many ways, such as cylindrical tubes, abstract polygons, organic forms, and plain boxes, all of which attempted to execute our central ideas as well as possible.

Final Form Process
Ideation, Main Idea

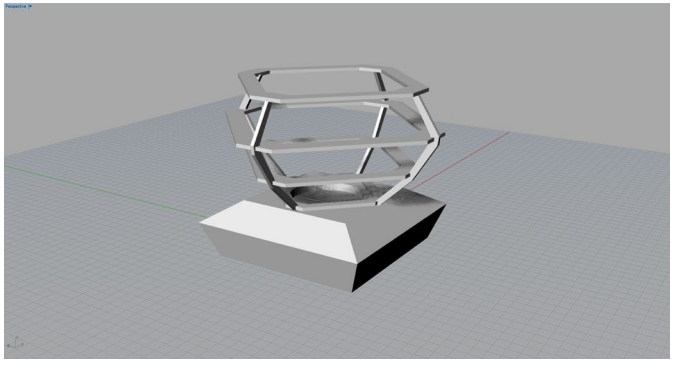


In our final design, we tried to keep the form as simplistic as possible in order to keep a strong emphasis on the function and interactivity of the device. Inside the main container would be suspended materials, that would be blown around by a DC motor fan underneath. Contained in the face plate at the front of the unit would be the on/off switch, potentiometer to control the speed of the fan, and an 7-segment display to report the speed of the potentiometer from a scale of 0-9. After we began the fabrication and further design processes, we decided to pivot away from the DC motor in favor of a servo motor. This is because it proved to be far too difficult to work with a DC motor, and we were not able to have it respond to the potentiometer. Additionally, we decided to remove the 7-segment display for a similar reason. Our Arduino programming skills were limited, and we were unable to find documentation to help us with incorporating it. Other final decisions include incorporating magnets to be able to access the main container, and circuit.

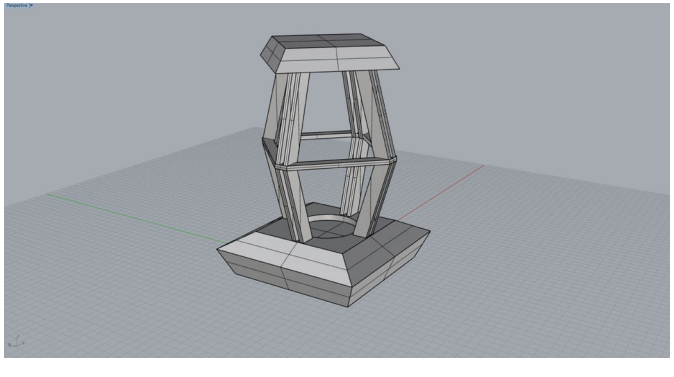
Final Form Process
Rhino Experimentation, Iteration 1 & 2



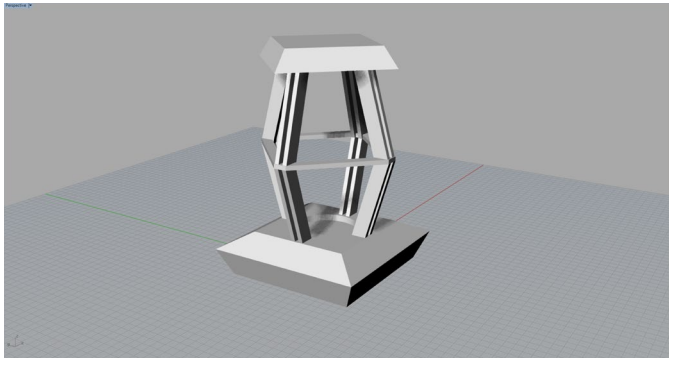
Shape 1, Shaded



Shape 1, Rendered

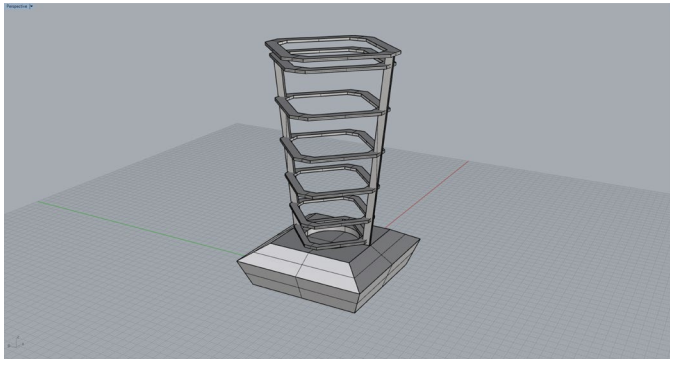


Shape 2, Shaded

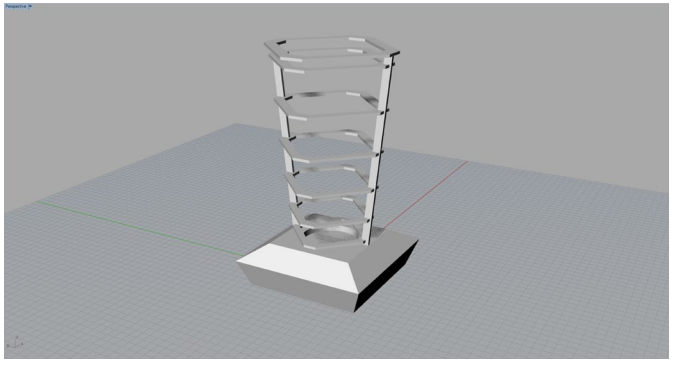


Shape 2, Rendered

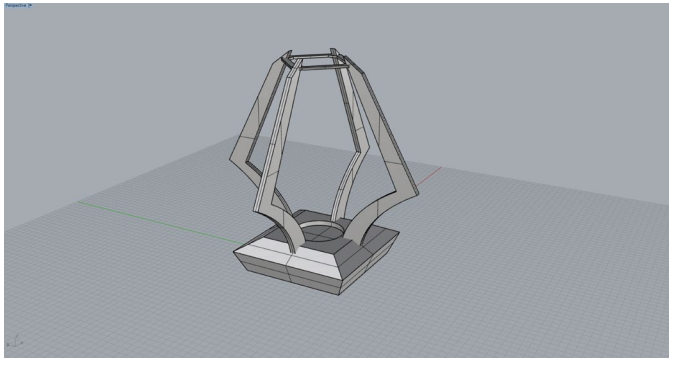
Final Form Process
Rhino Experimentation, Iteration 3 & 4



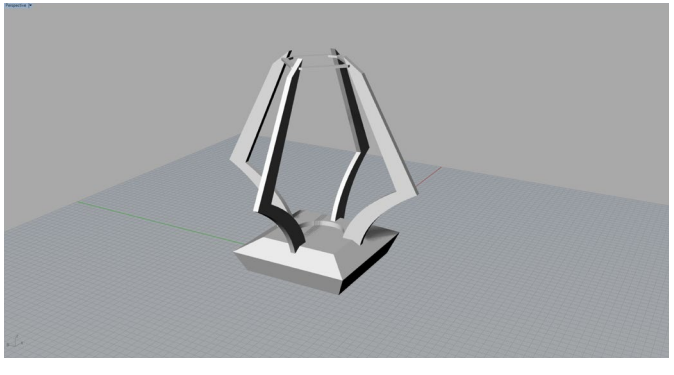
Shape 3, Shaded



Shape 3, Rendered

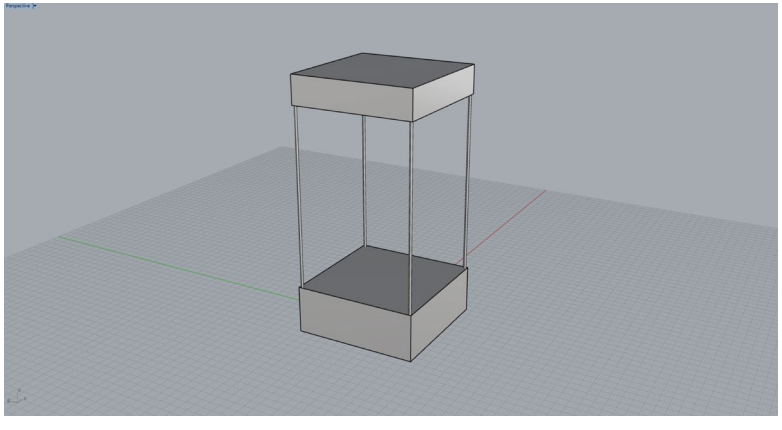


Shape 4, Shaded

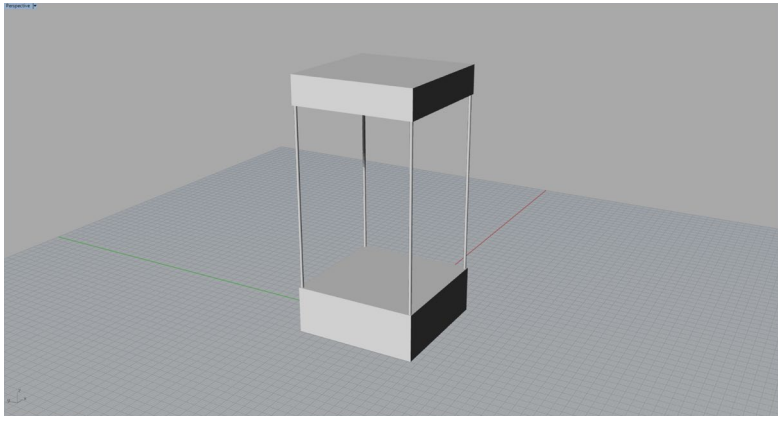


Shape 4, Rendered

Final Form Process
Rhino Experimentation, Final Iteration



Final Shape, Shaded

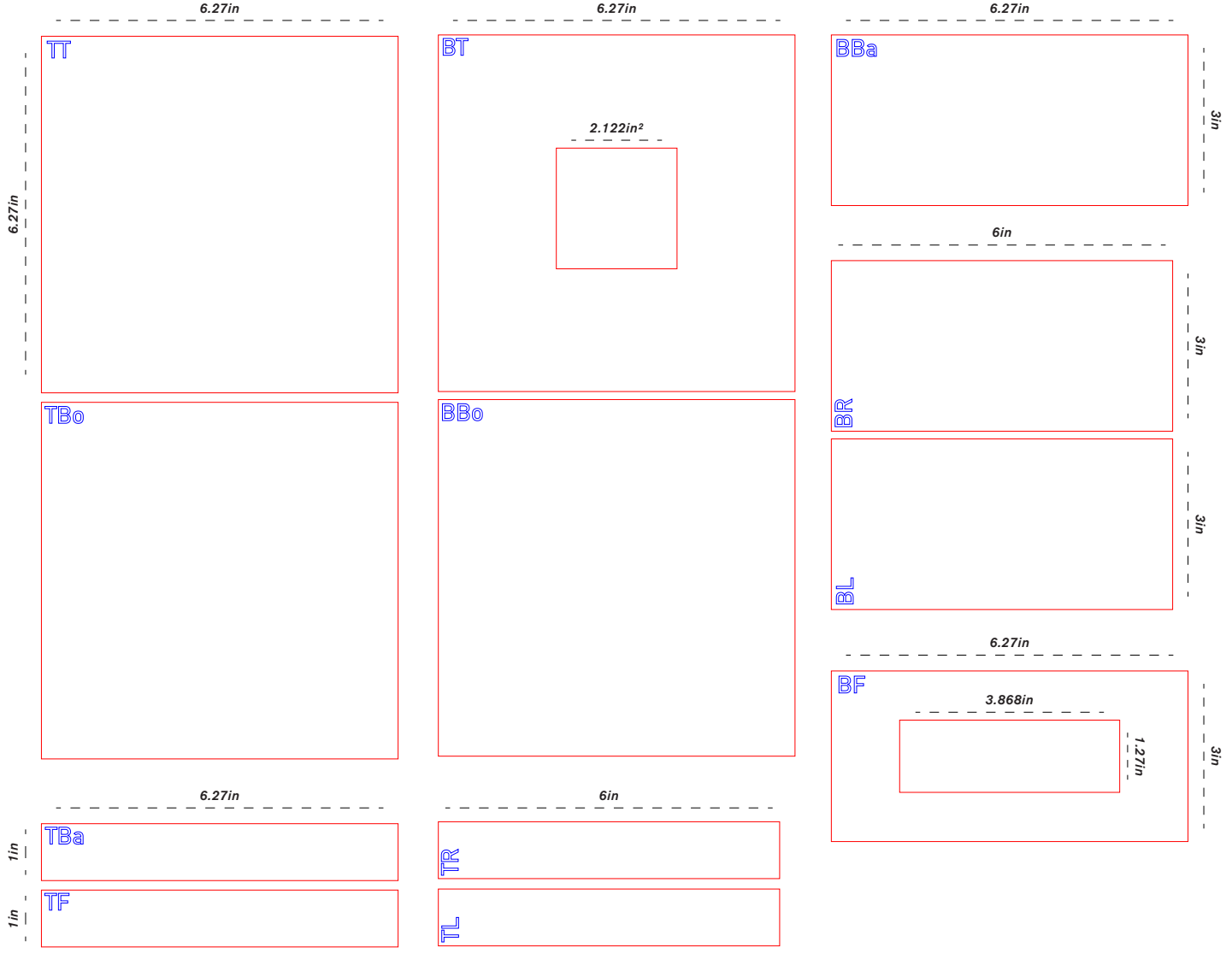


Final Shape, Rendered

The reason why we chose this design as our final shape is because of its simplicity. We wanted the main function of our shape to be the aspect of it that is most noticeable, and immediately apparent, while also not being uninteresting or bland. To accomplish this, we created a design that had the right proportions to fit our components, as well as being aesthetically pleasing, with a simple construction.

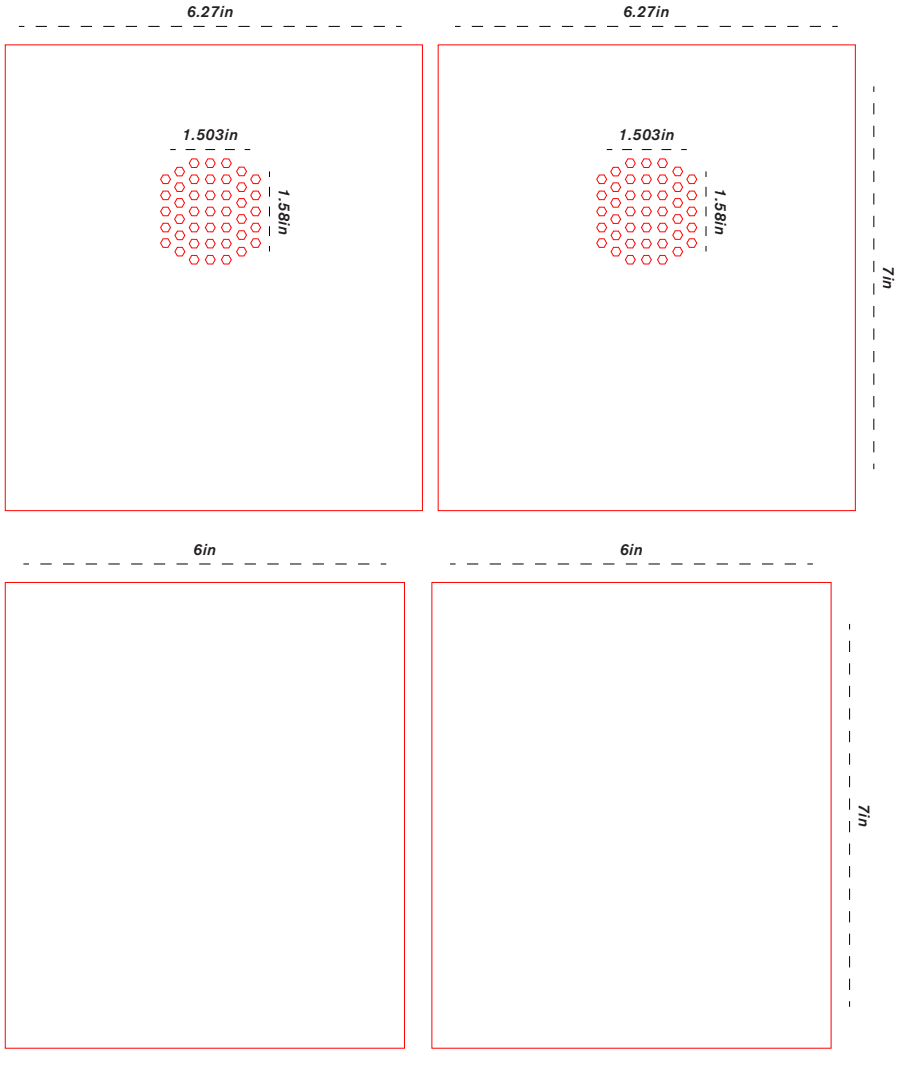
Final Form Process

Fabrication - Illustrator File (Wood)



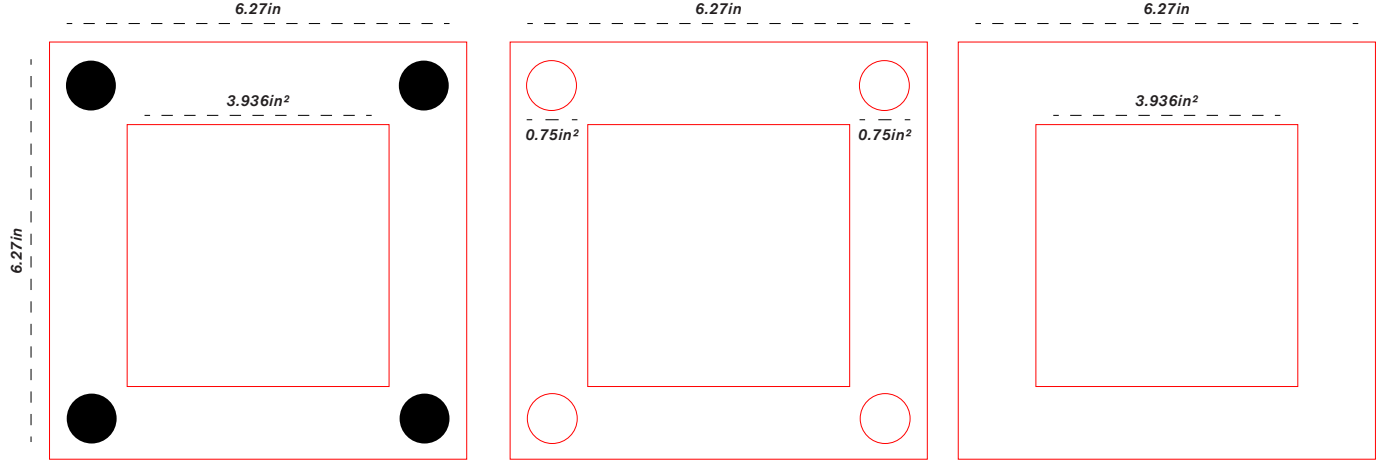
Final Form Process

Fabrication - Illustrator File (Acrylic)

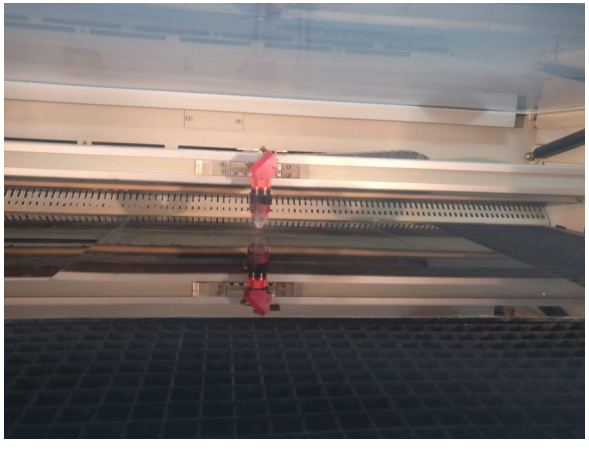


Final Form Process

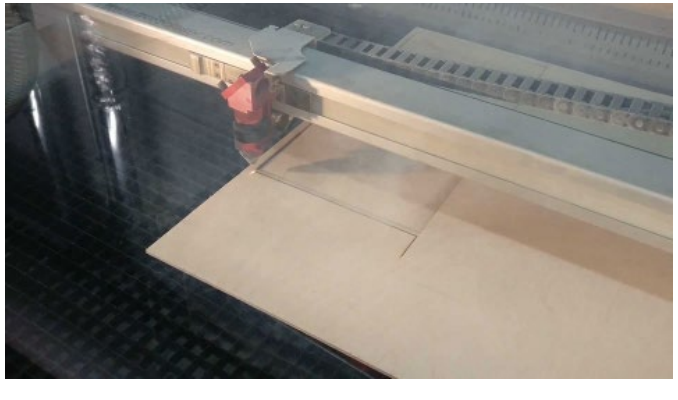
Fabrication - Illustrator File (Magnet Holes)



Final Form Process
Fabrication - Laser Cutting



Acrylic

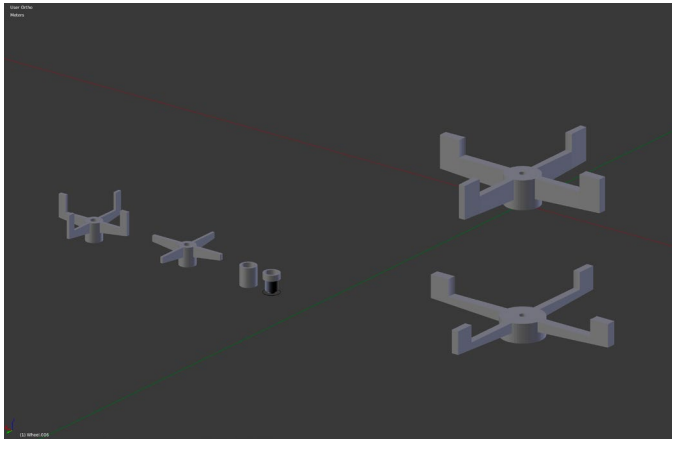


Wood Cutting (Video)

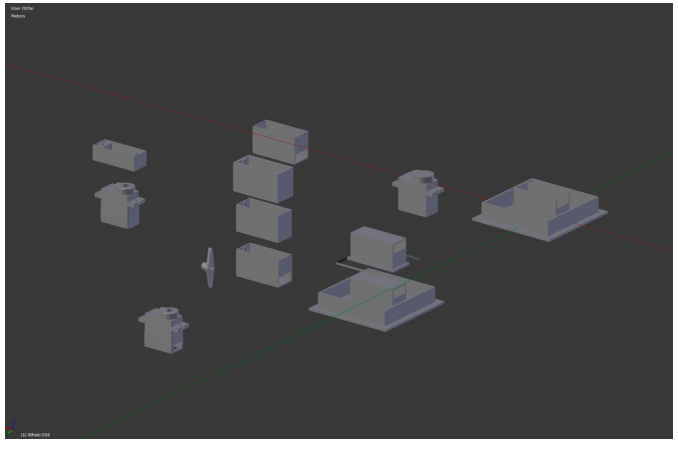


Acrylic Cutting (Video)

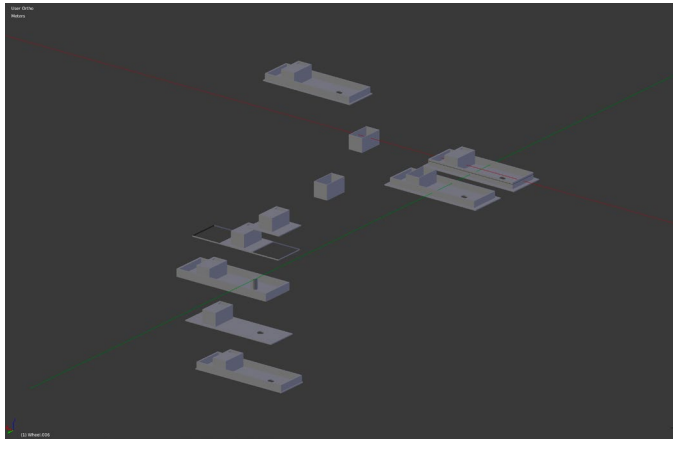
Final Form Process
3D Modelling, Component-Fitting Pieces



Propeller Iterations and Progression

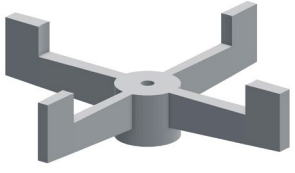


Servo Casing Iterations and Progression (Measurements from a thingiverse.com model)



Switch Casing, and Final Front-Plate Iterations and Progression

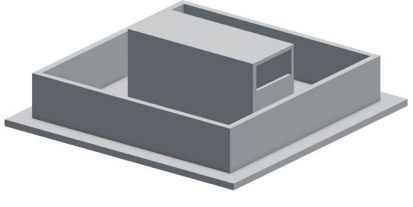
Final Form Process
3D Modelling, Final Pieces



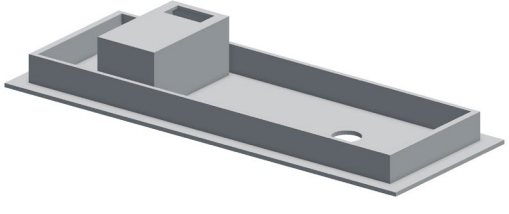
Propeller



L-Bracket To Reinforce Form

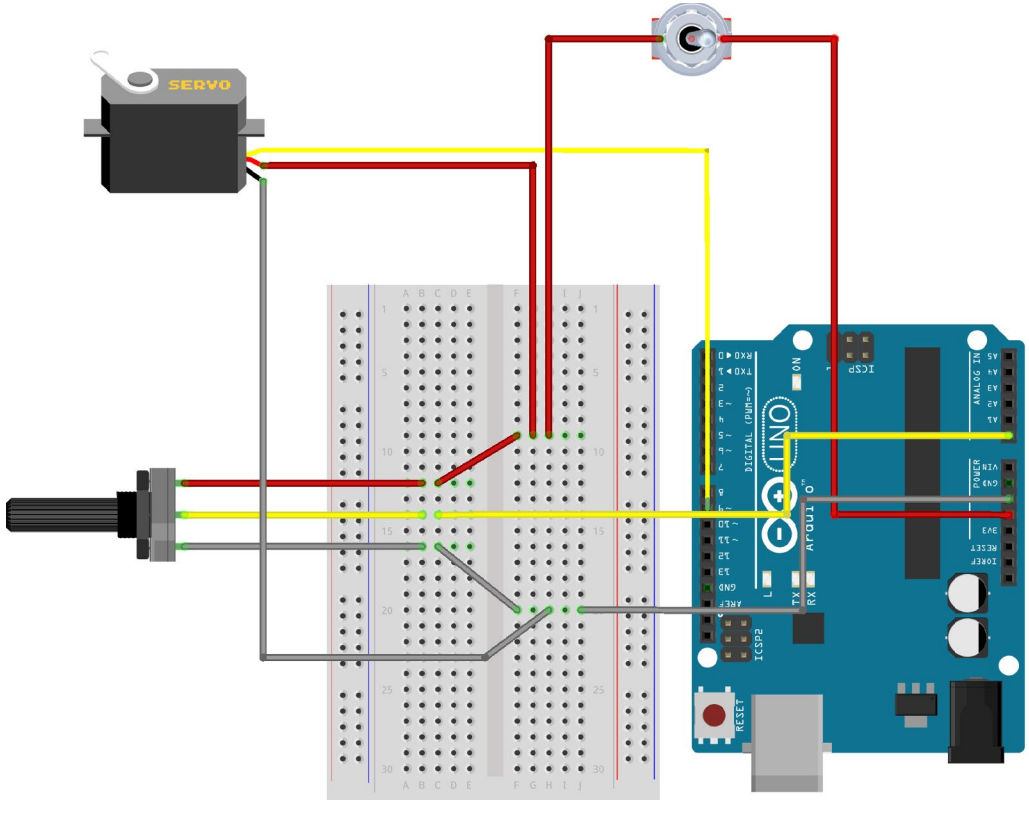


Servo Motor Casing

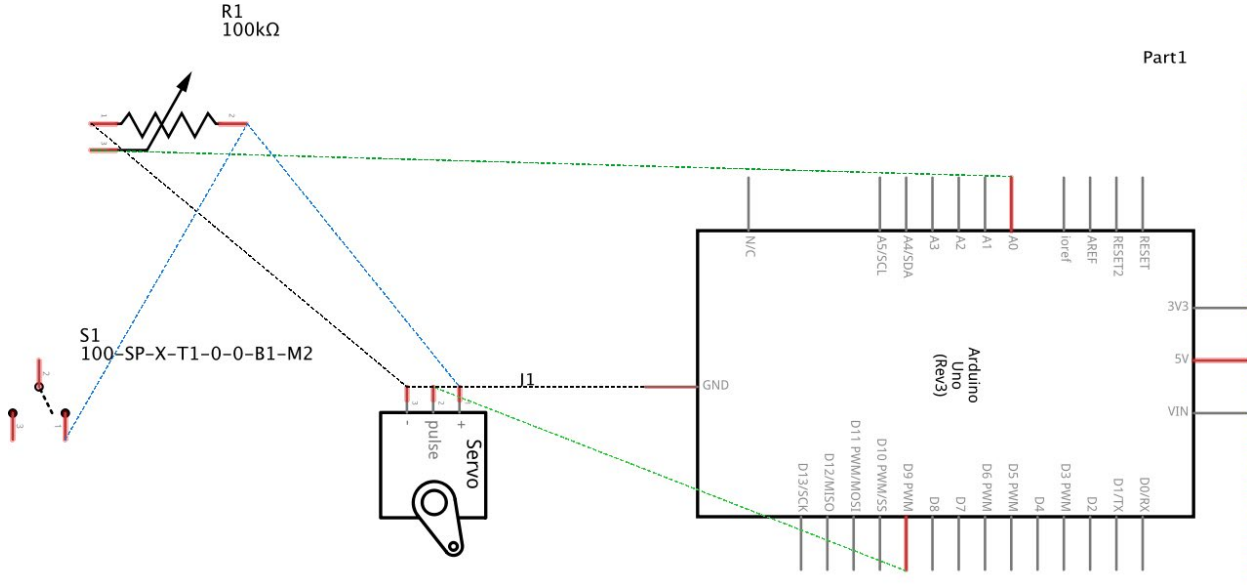


Face Plate For Switch and Potentiometer

Final Form Process
Circuit Construction, Fritzing



Final Form Process
Circuit Construction, Schematic



Final Form Process
Circuit Construction, Arduino Code


```
#include <Servo.h>                  // add servo library

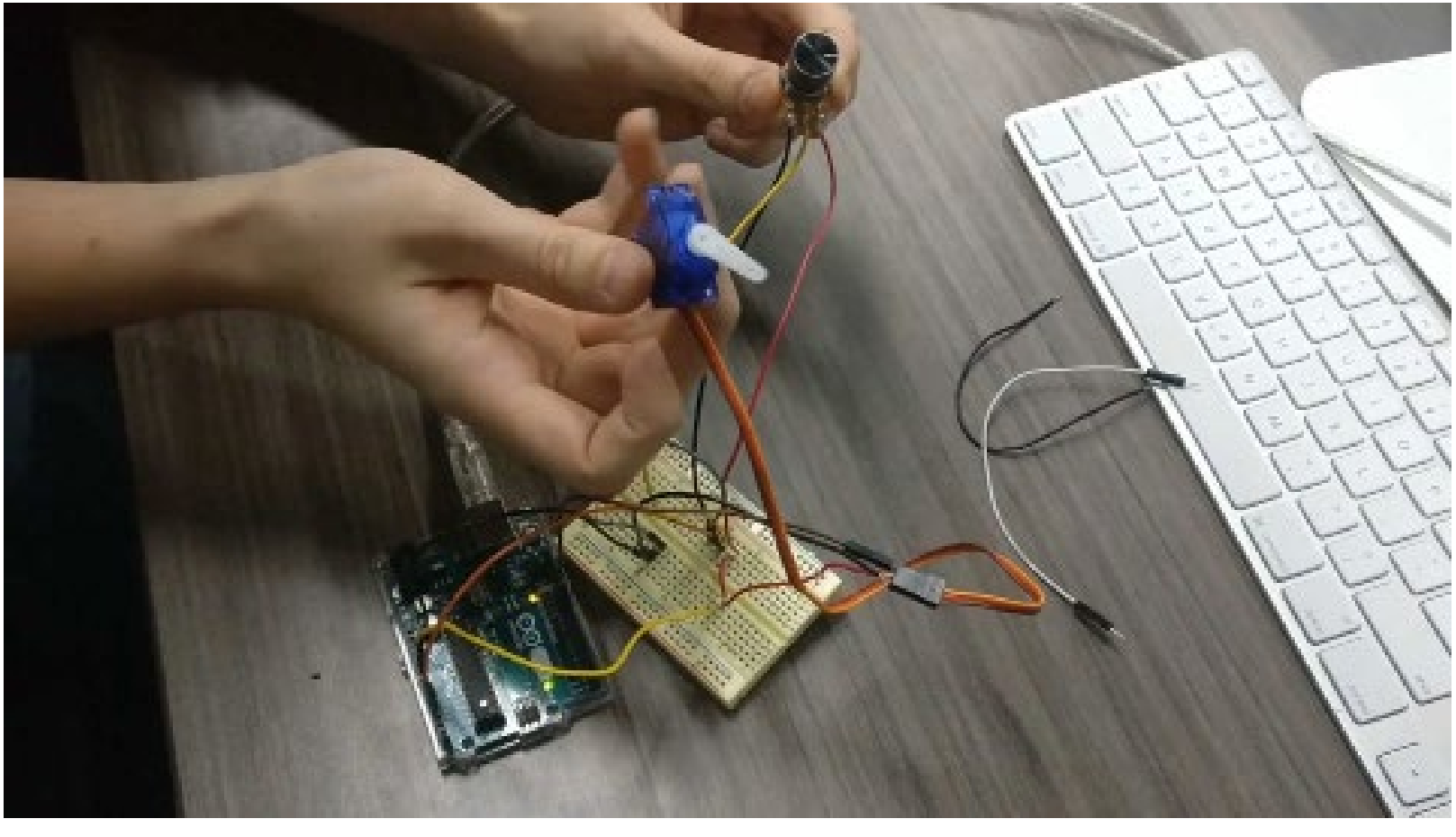
Servo myservo;                      // create servo object to control a servo

int potpin = 0;                     // analog pin used to connect the potentiometer
int val;                            // variable to read the value from the analog pin

void setup() {
  myservo.attach(9);                // attaches the servo on pin 9 to the servo object
}

void loop() {
  val = analogRead(potpin);         // reads the value of the potentiometer (value between 0 and 1023)
  val = map(val, 0, 1023, 0, 180);  // scale it to use it with the servo (value between 0 and 180)
  myservo.write(val);               // sets the servo position according to the scaled value
  delay(15);                        // waits for the servo to get there
}
```

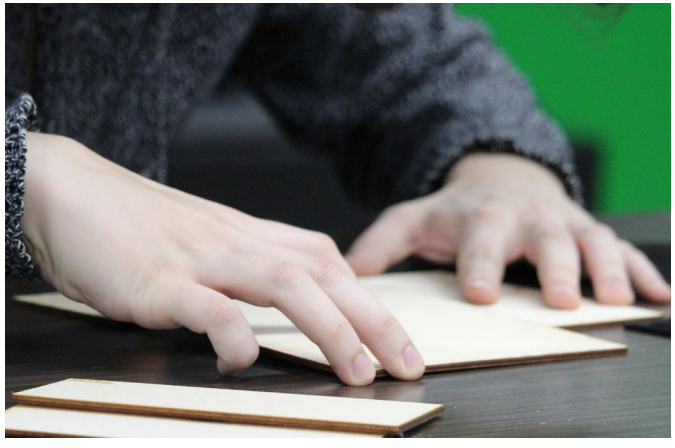
Final Form Process
Circuit Construction, Functioning



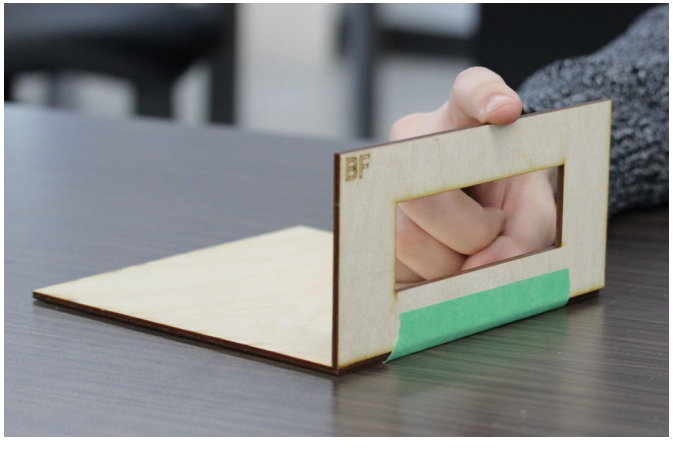
Final Form Process
Assembly



Step 1: *The potentiometer and switch were inserted inside the shell.*



Step 2: *Before the process of gluing the base together, we planned and made sure that all the sides fit accordingly.*

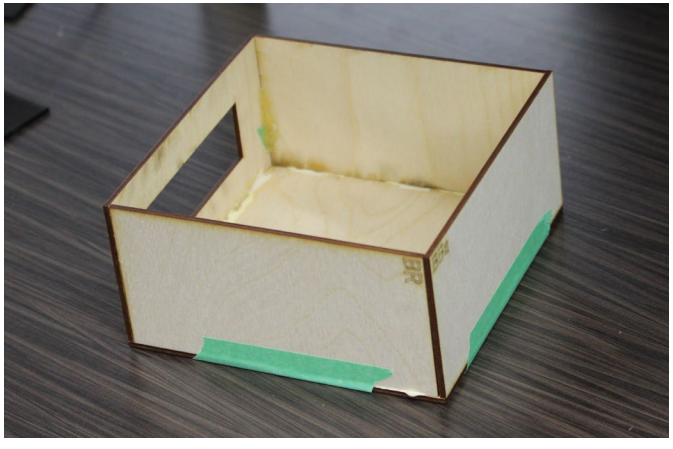


Step 3: *Tape was added at the folds to make sure that the wood did not shift in the process of gluing.*

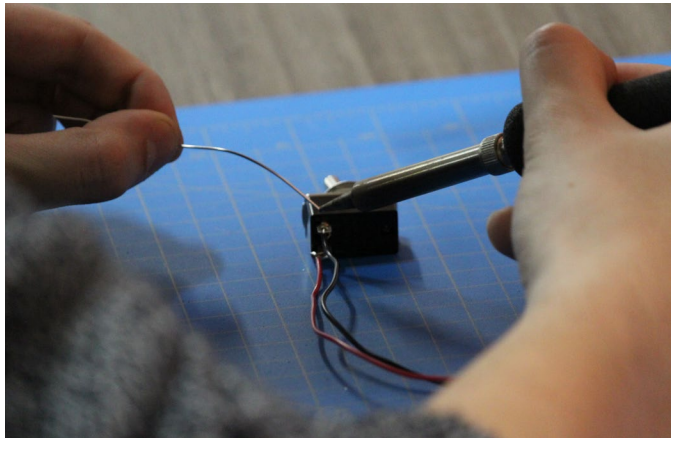


Step 4: *Once the line of glue was added, and the side was positioned in place, tape was added on the inside to ensure stability.*

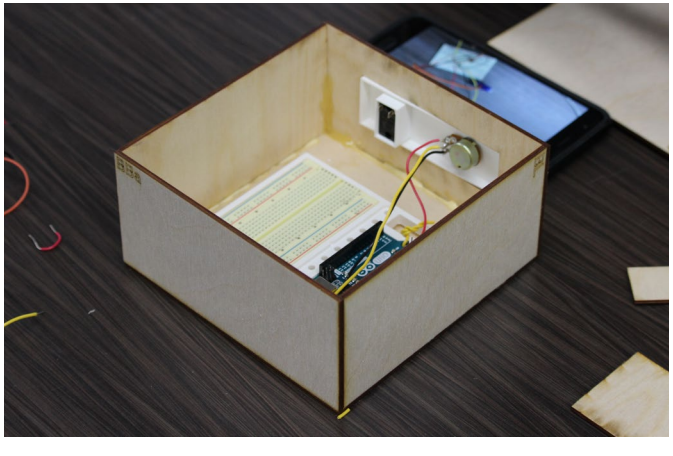
Final Form Process
Assembly



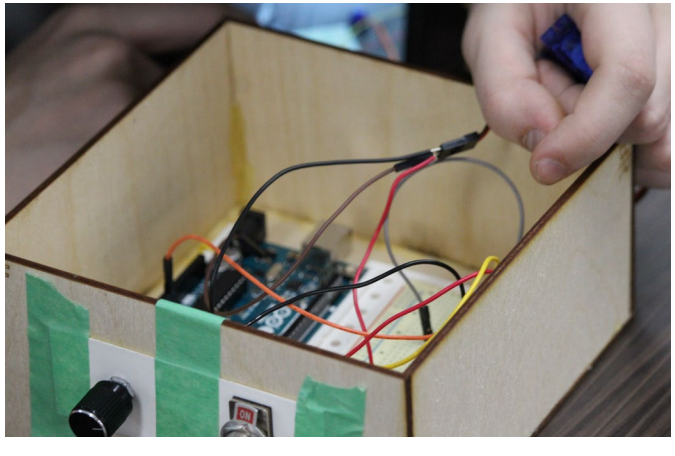
Step 5: *Once the process of gluing and adding tape for structural support was finished, the unfinished base was left to dry for 10 minutes.*



Step 6: *Wires were soldered to the pins of the potentiometer.*

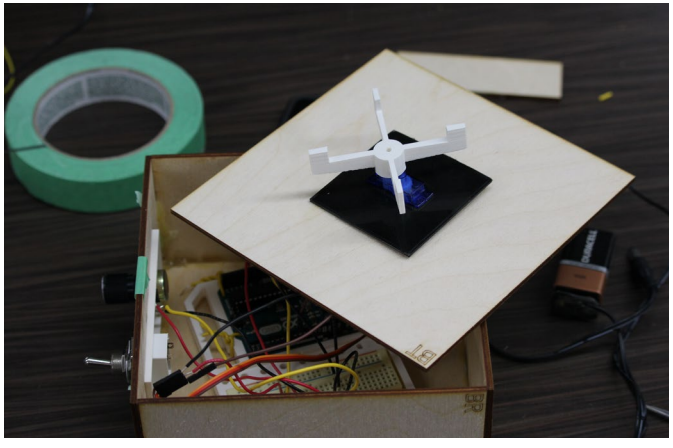


Step 7: *The circuit which incorporated an Arduino and breadboard was placed into the wooden base.*

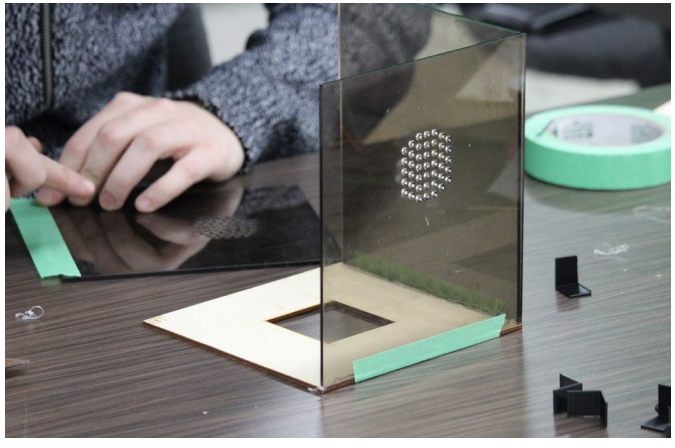


Step 8: *The potentiometer, switch, servo motor, and wires were inserted into the correct pins.*

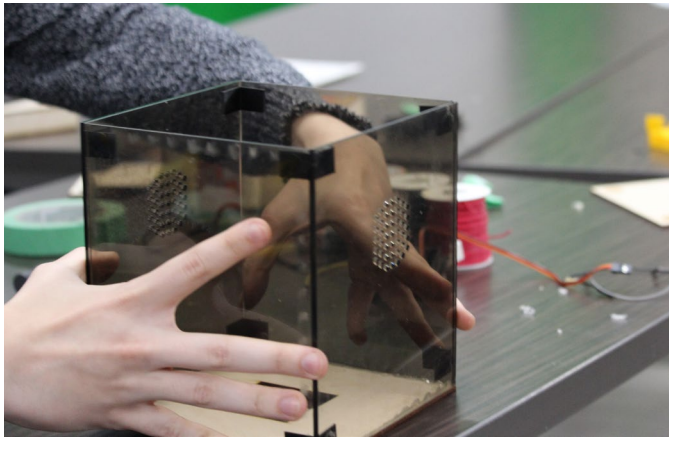
Final Form Process
Assembly



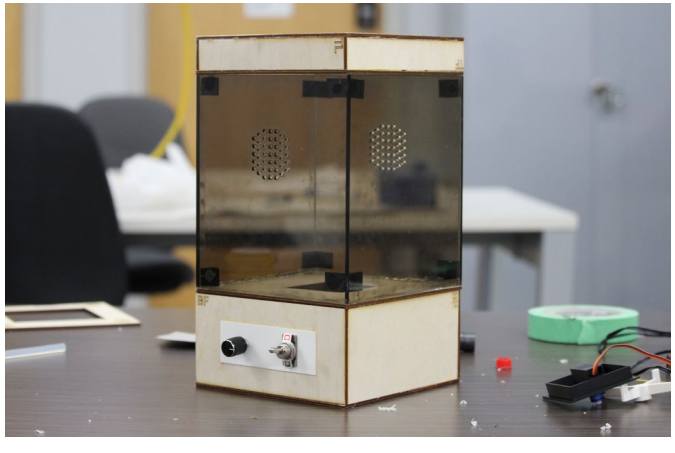
Step 9: *The servo motor was placed into the 3D printed shield and inserted into the top side of the wooden base.*



Step 10: *Started the process of gluing the acrylic onto the top face of the base. Used tape to guide the acrylic and to prevent the acrylic from moving.*

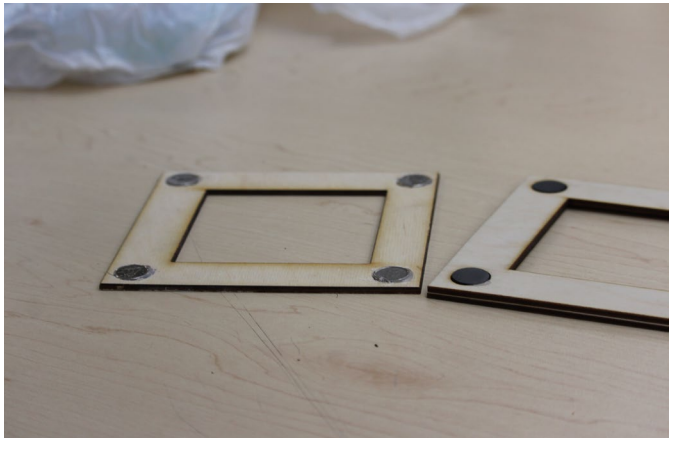


Step 11: *Once all the acrylic sides were placed into position and the glue has dried, 3D printed L-brackets were glued at the top and bottom corners.*

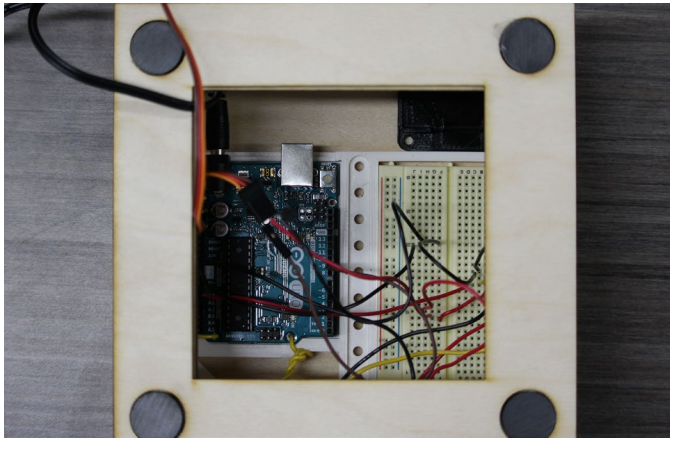


Step 12: *The top, wooden lid was put together the same way the using steps 3, 4, and 5.*

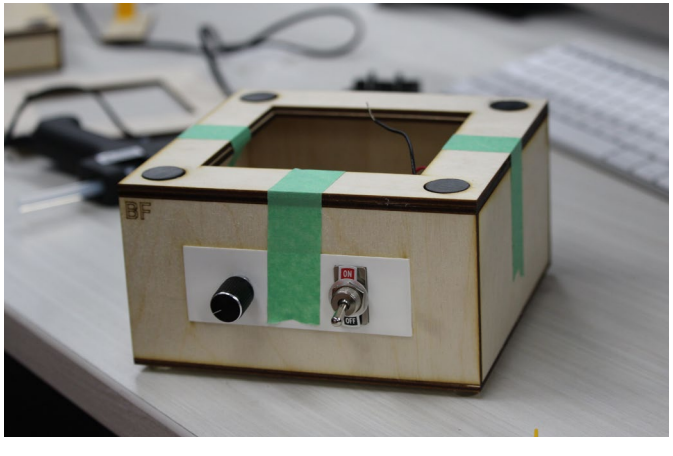
Final Form Process
Assembly



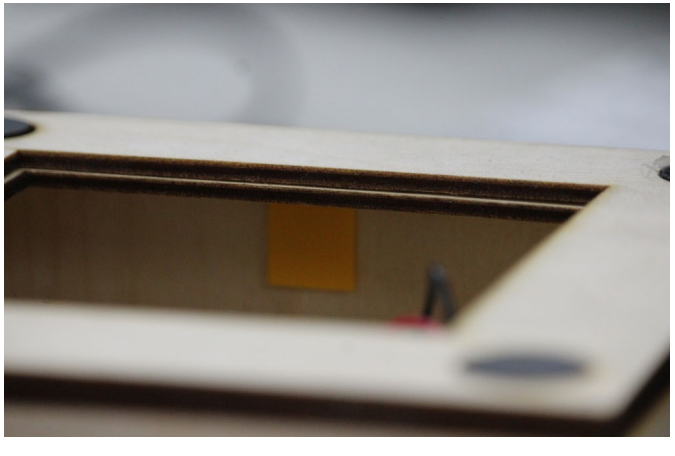
Step 13: *Began to build the magnetic lid between the base and acrylic section. Used a rotary tool to engrave the slots which the magnets would be inserted into.*



Step 14: *Glued the magnets into the slots using hot glue. Arduino and breadboard case was acquired from thingiverse.com and 3D printed*

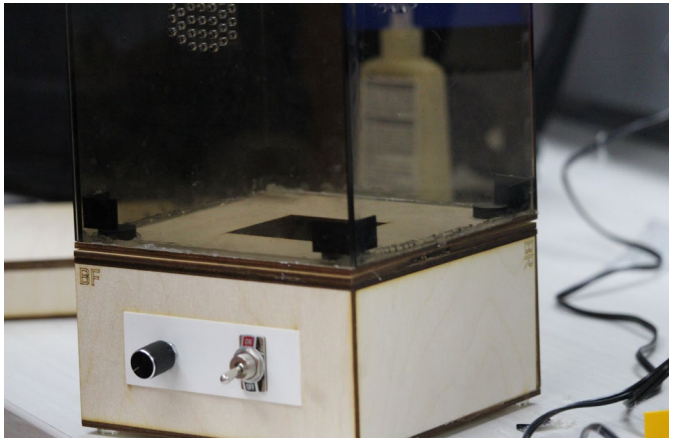


Step 15: *Before gluing the magnetic lid, tape was added onto each side so prevent the lid from moving while glued.*

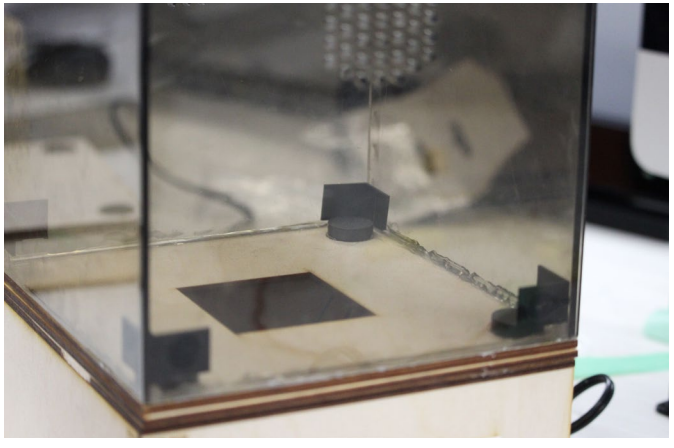


Step 16: *The magnetic lid was glued on top of the opening of the base by placing L-brackets in the inner edges.*

Final Form Process
Assembly



Step 17: *The opposite pair of the already attached magnet on the top of the base, was placed inside the 4 corners of the acrylic container.*



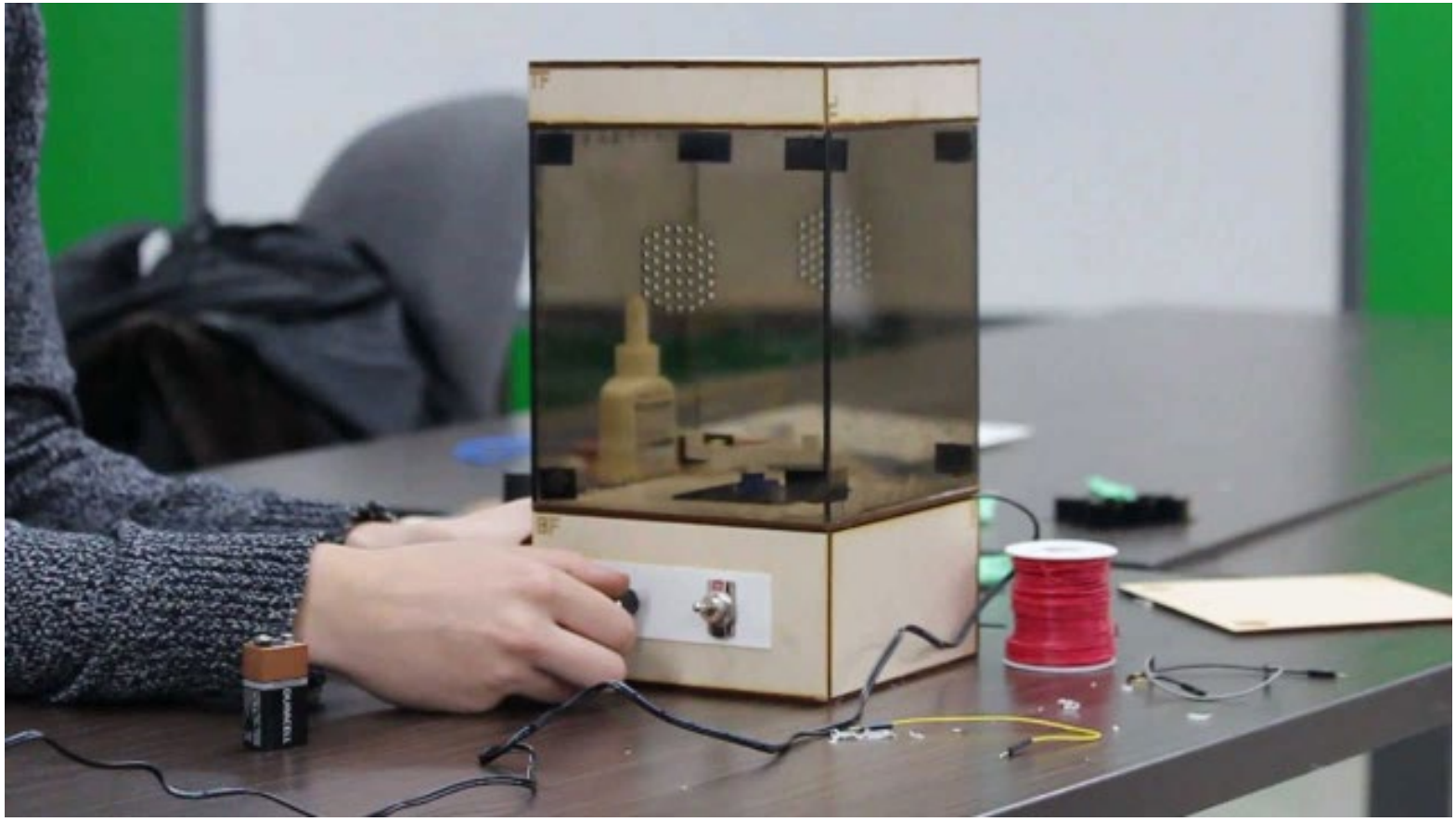
Step 18: *Using hot glue, the magnets were attached.*



Step 19: *Using the same steps from step 15 and 16, the magnetic lid between the acrylic lid and top section was added.*

Final Form Process

Final Form, Video



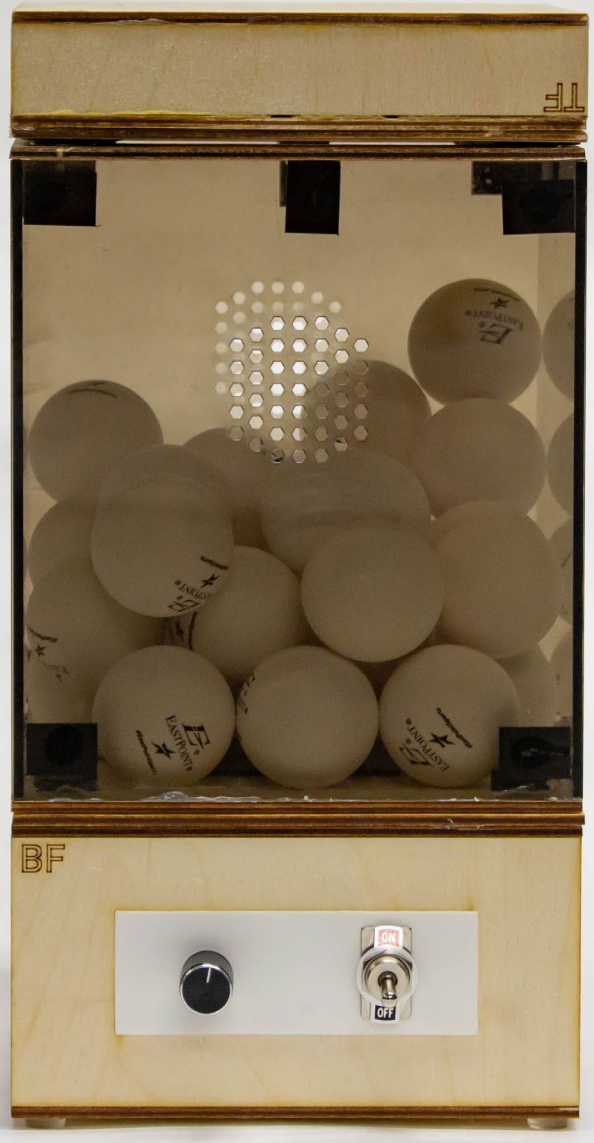
Final Form Process

Final Form, With Objects (Ping Pong Balls)



Final Form Process

Final Form, Front



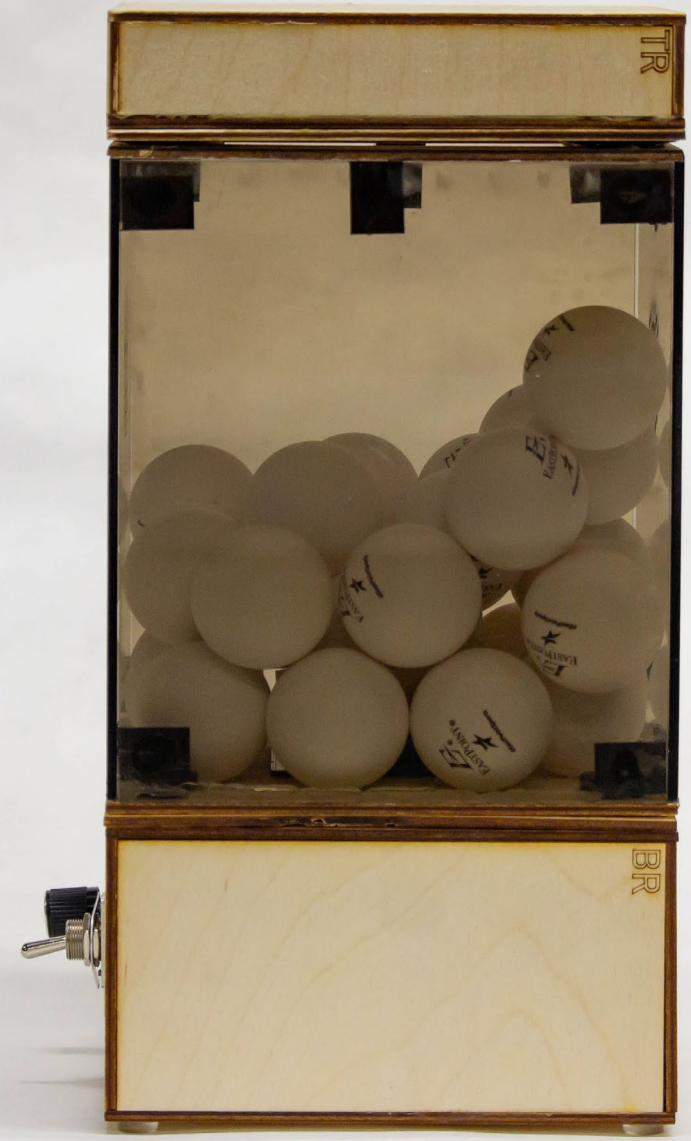
Final Form Process

Final Form, Left



Final Form Process

Final Form, Right



Final Form Process

Final Form, Back

