M&M Dispenser

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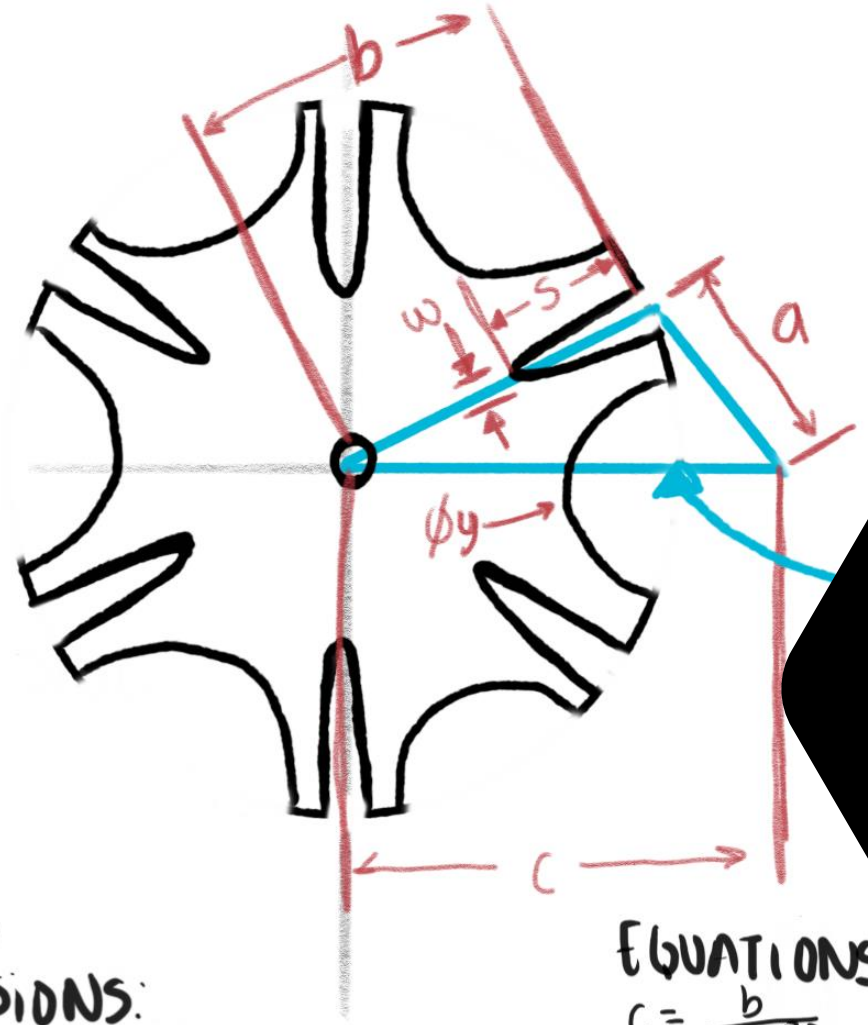
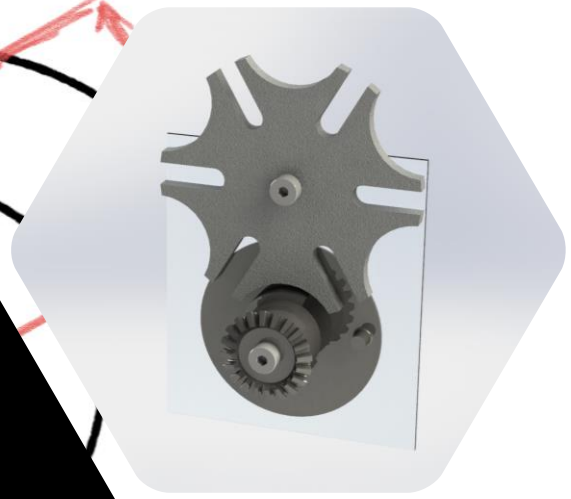
ME102 Fall 2020

OBJECTIVES

- Create a mechanical desktop candy dispenser that creatively integrates rotatory motion, springs, stock components and 3D printed pieces
- Be able to store at least 10 M&M's at a time, dispensing only 1 per user input
- Resets itself after dispensing
- Be operable with one hand





Concepts and Prototyping

DRIVING DIMENSIONS:

- $n = 6$ (# of slots)
- $p = .20$ in (pin diameter)
- $b = 1.75$ in (radius of wheel)
- $t = .1$ in (tolerance / clearance for printing)

EQUATIONS

$c = \frac{b}{\sin(\frac{180}{n})}$ (cen

$a = \sqrt{c^2 - b^2}$ (Gene

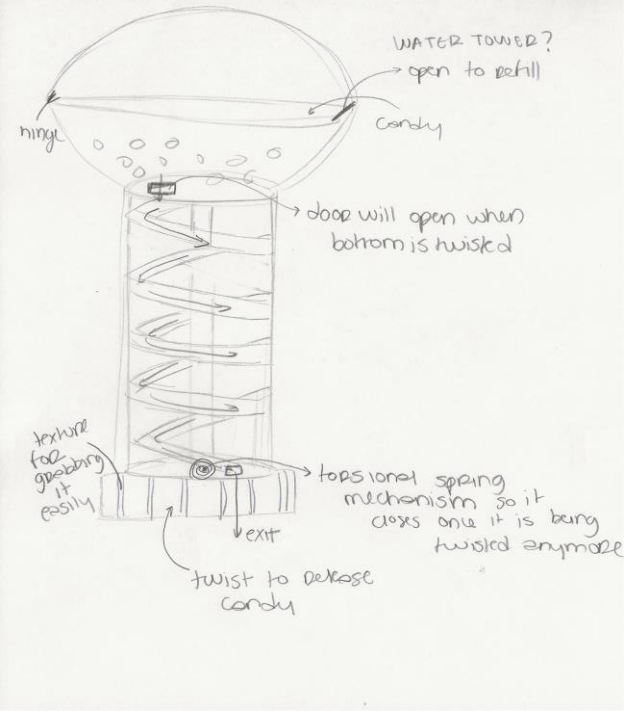
$s = (a+b) - c$ (slot center length) →

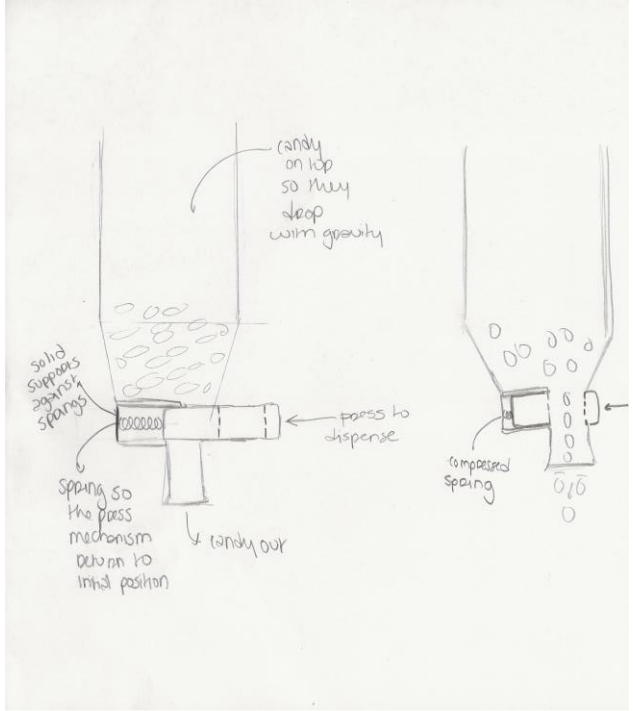
$w = p + t$ (slot width) →

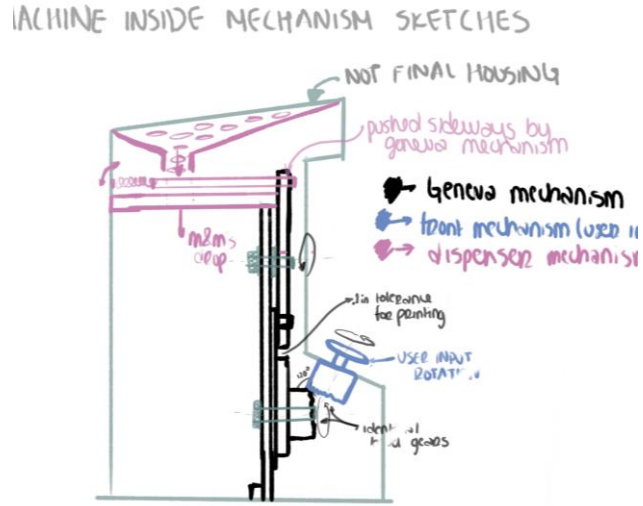
$y = a - (p * 1.5)$ (stop arc radius) →

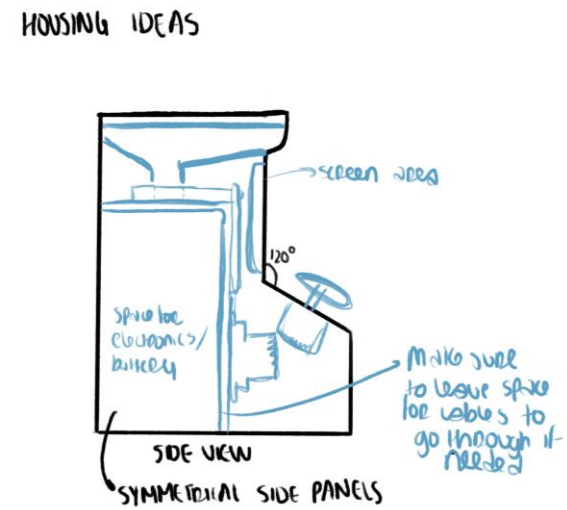
$z = y - t$ (stop disc radius) →

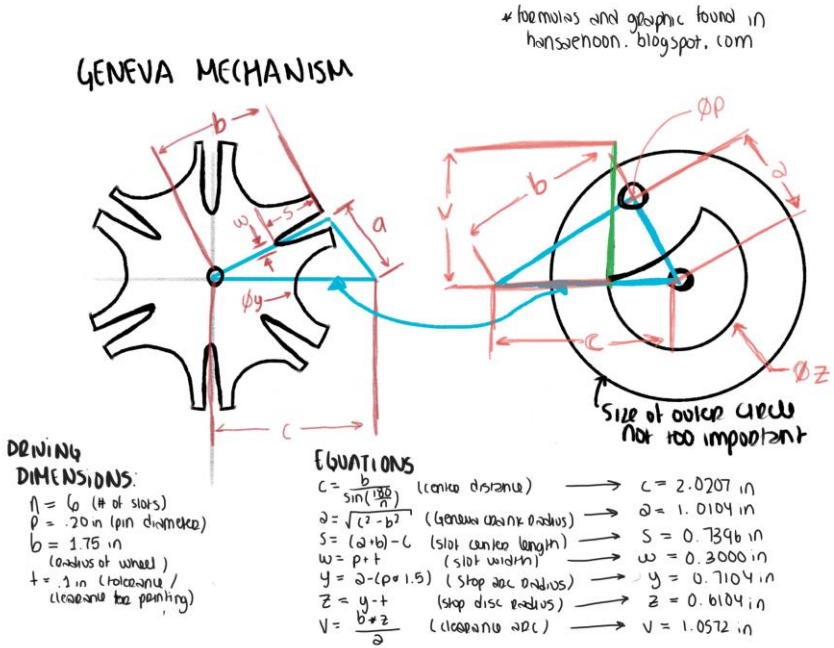
$V = \frac{b * z}{a}$ (clearance arc) → $V = 1.0572$ in











During my first sketches, I mainly focused on how to incorporate rotary motion and springs into a passive dispenser mechanism. Most of my designs relied on gravity to do most of the work after the initial input. I was first inspired by simple water tower designs.

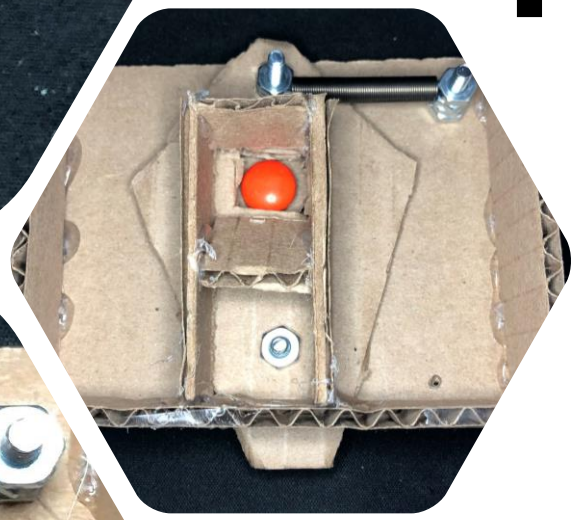
Later on, I found out about Geneva Drives through a short film documentary that YouTube randomly suggested, and I was intrigued by this concept of continuous rotary motion that becomes intermittent so I began thinking about how I could possibly use it in my design to learn more about it.

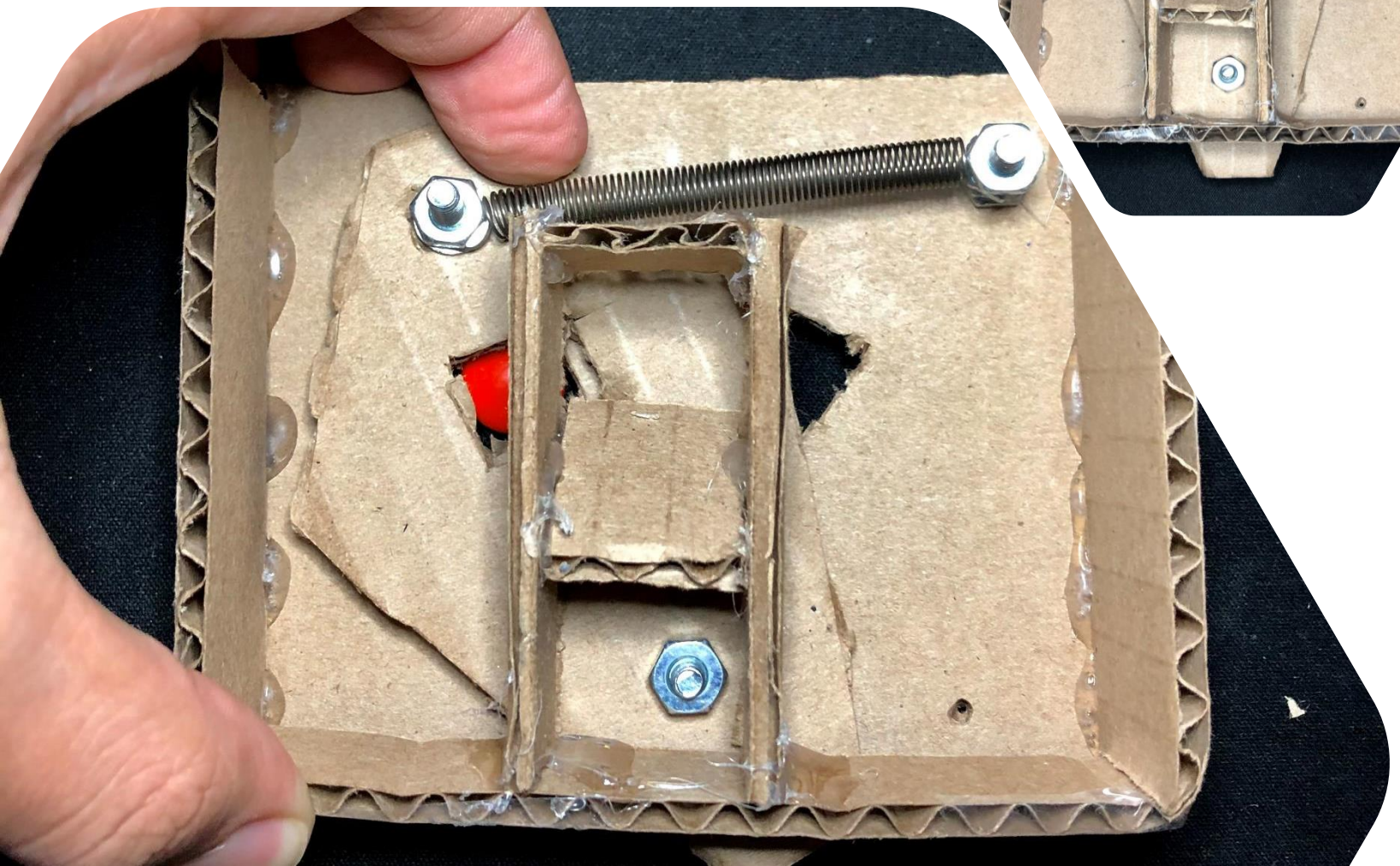
PROTOTYPING

As I began prototyping, one of the main questions that I set out to answers was how to even make a Geneva wheel and how would it interact with the dispensing part of the mechanism? I realized through this process how much tolerances matter for the Geneva drive as a slight misalignment caused unwanted behavior. This became obvious during my second round of prototyping with stock components that allowed for smoother rotation, which I thought would result in a reliable Geneva drive only to find out it would not turn because the tolerances were too low and, especially when working with prototyping materials, this was quite difficult to achieve.

I also started thinking about user input as an arcade machine driving game through which the user would turn the steering wheel which would connect to a 120° bevel gear which would then turn the Geneva drive and push a button on a perpendicular plane that would retract momentarily to dispense an M&M.

PROTOTYPING DISPENSER





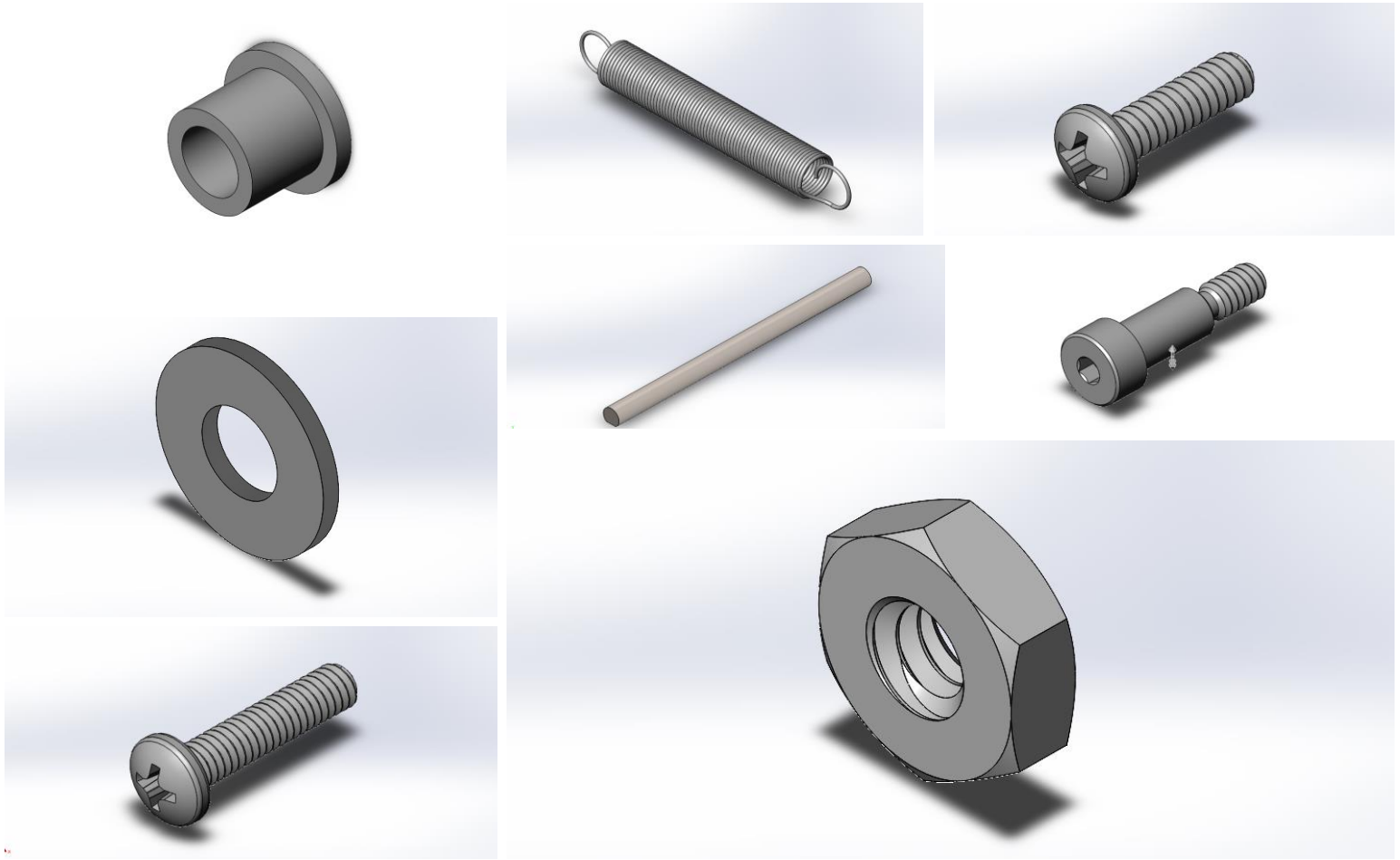
The first button dispenser had a major problem: the profile of the Geneva wheel pressing it was not big enough to depress the button substantially. However, as I tried to find a solution, I realized my materials were deforming from sideways pressure which made me think about using the Geneva wheel to instead apply a tangential force to a lever arm which would then move sideways to dispense the candy and return to its stable position in the center. This was achieved through useful feedback and a suggestion of placing a spring above the top of the lever, making it stable in the center and able to move bidirectionally with only one extension spring.

Processes

Through most of the project, I worked by using rapid prototypes, then CAD/Math calculations and quick test prints. This last part was essential to guaranteeing that pieces would fit appropriately depending on what they needed to do such as constrain or allow for movement. After building physical prototypes, I iterated between test prints and CAD to fine-tune all the measurements not only for each piece but also for each filament I was using because I noticed that not all the filament colors extruded the same! What was a tight fit for one color/brand was loose for another one so that required further planning.

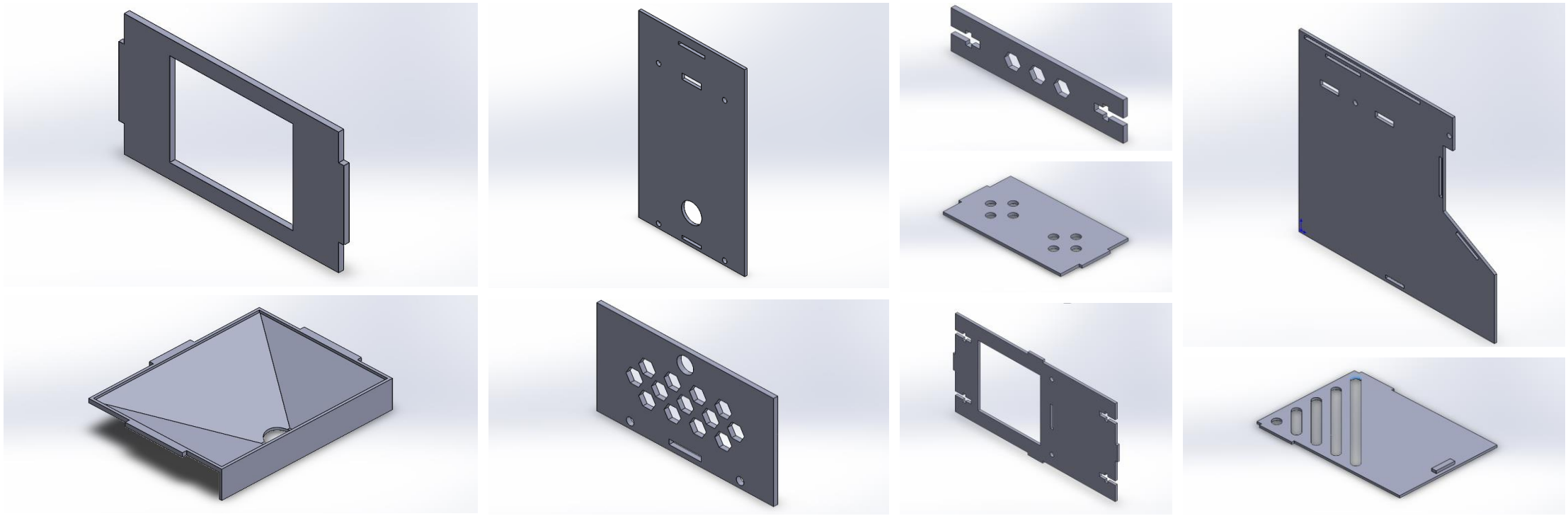
CAD PARTS AND ASSEMBLIES

STOCK COMPONENTS

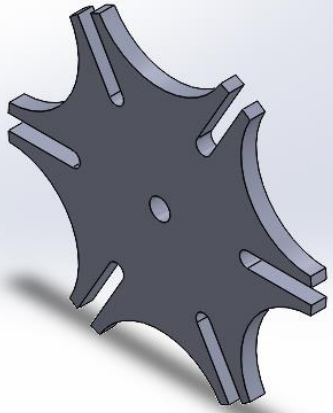


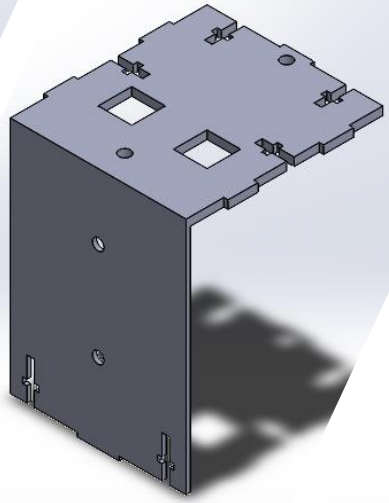
Top left to bottom right: ¼” nylon sleeve bearing, steel extension spring, zinc ¾” machine screw, stainless steel flat washer, stainless steel D-shaft, nylon ½” shoulder screw, zinc 1” machine screw, low-strength steel hex nut

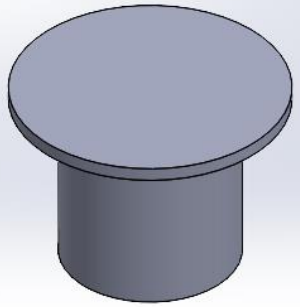
Assembly Exterior Housing

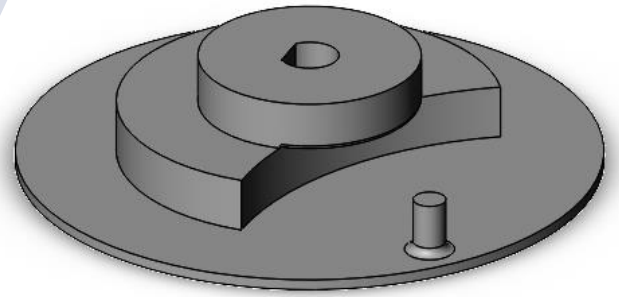


From top left to bottom right: screen front panel, back panel, front top panel above screen, inclined panel for buttons, side panel, candy holder that slides one candy at a time into dispenser, front bottom panel, base panel, sliding panel on top of assembly



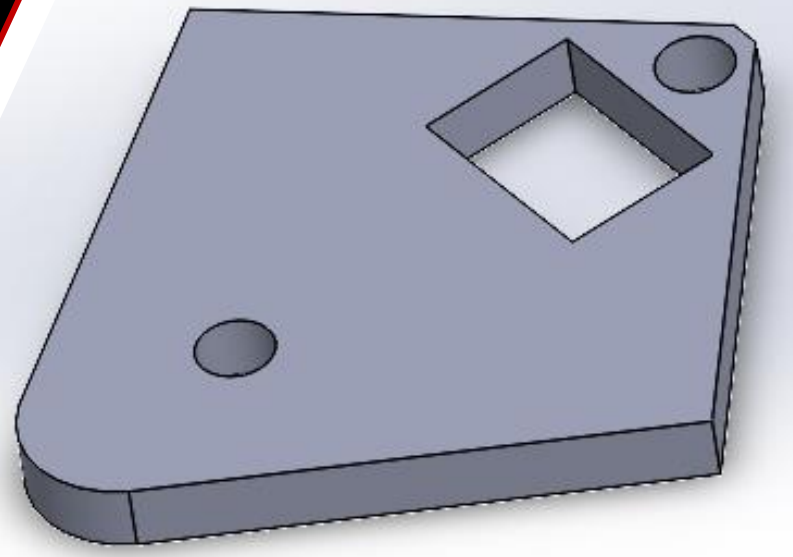


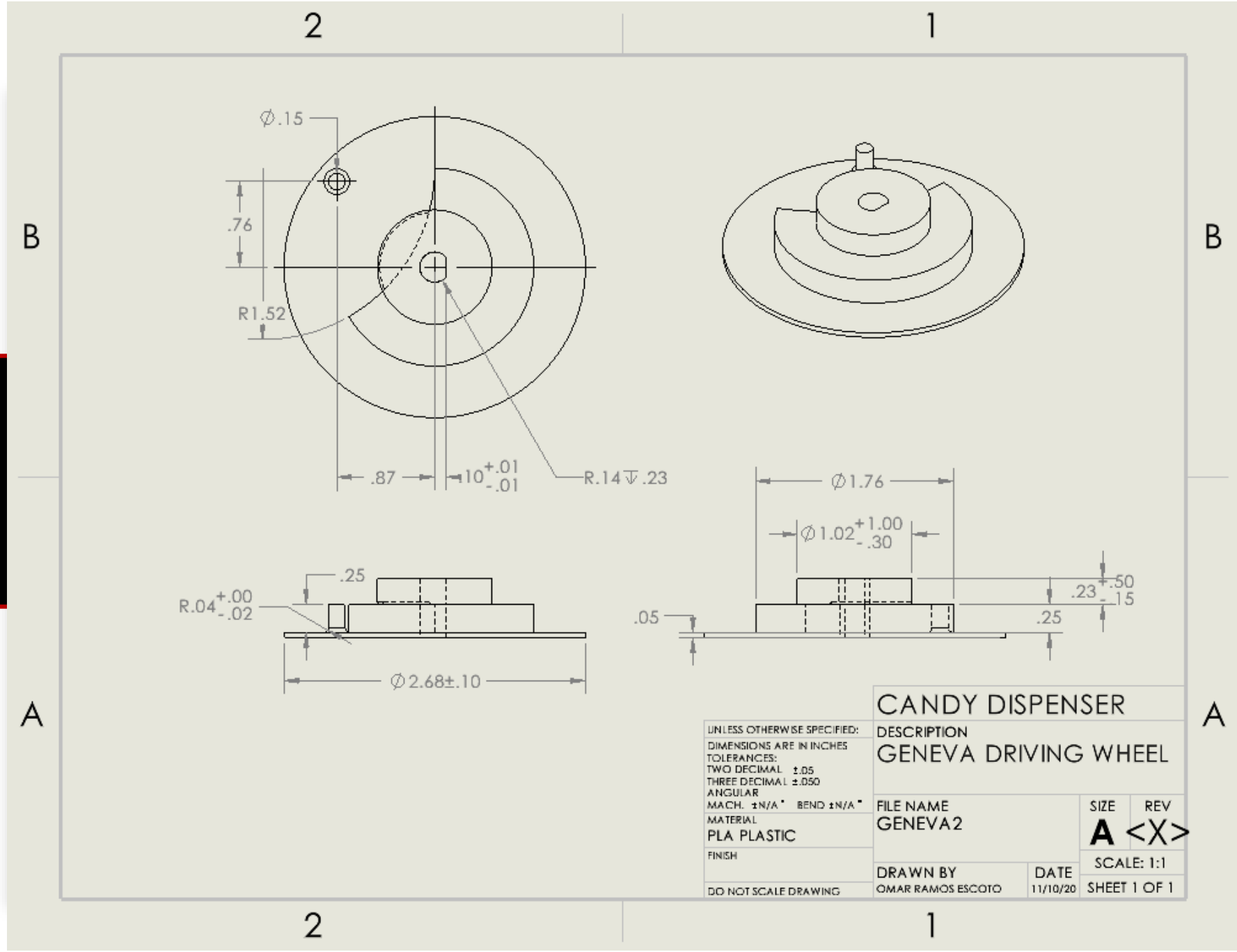




Active Mechanism Parts

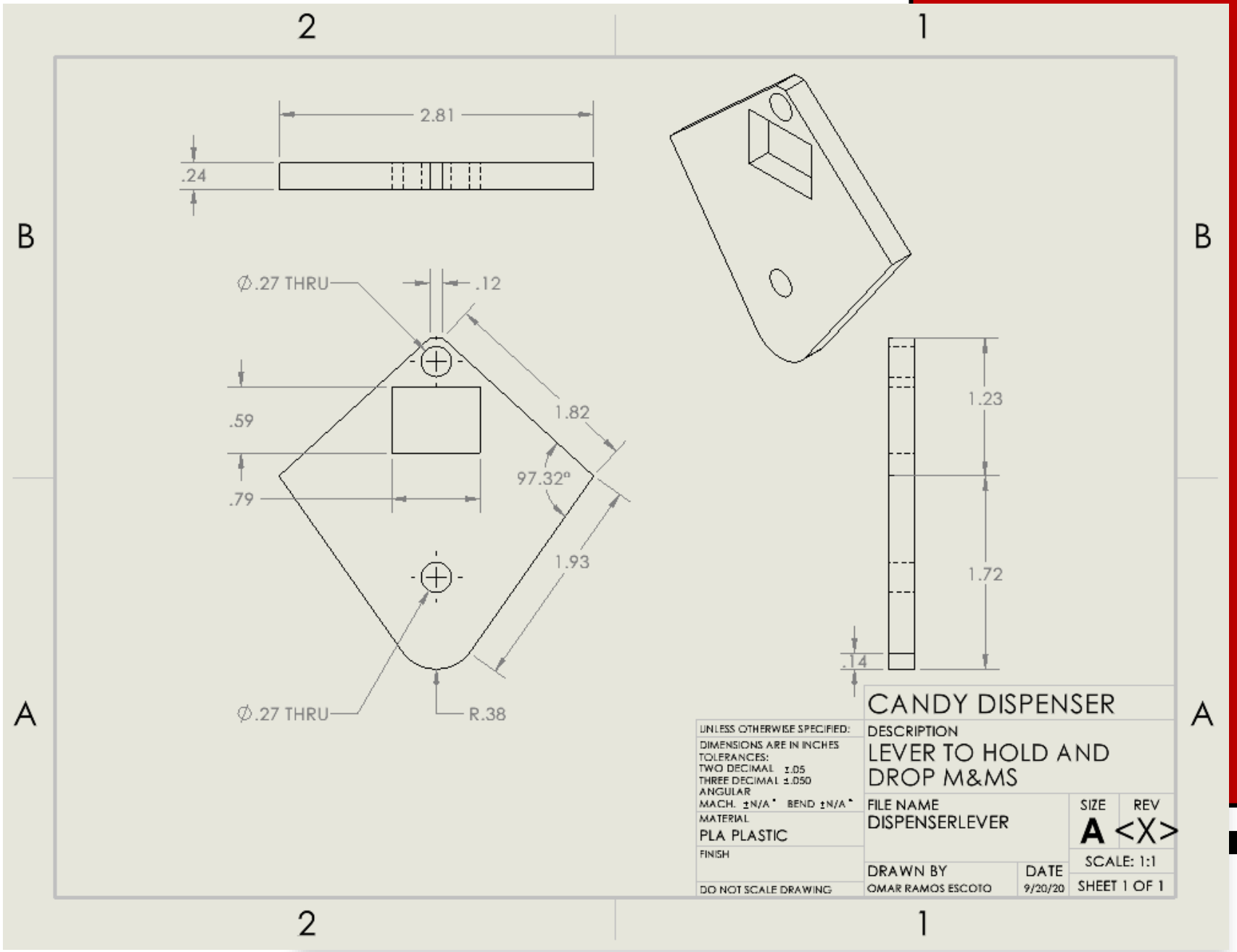
Clockwise: Geneva mechanism driven wheel, internal plate connecting the bottom panel to back panel and serves as the base for the Geneva mechanism and the dispenser, low-profile tight-fit bearing that goes into dispenser and serves as a hook for extension spring (also doubles as fake buttons), Geneva mechanism drive wheel with a D-shaft cut-out, dispenser

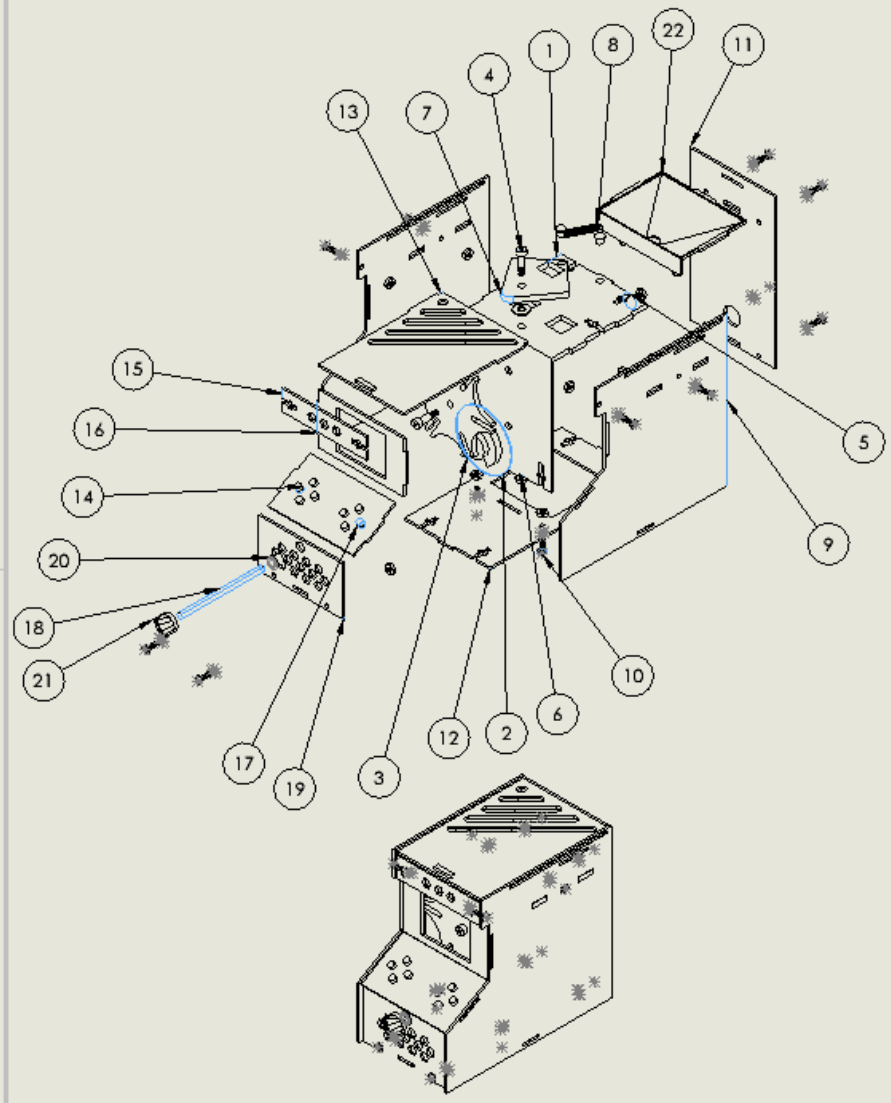




Engineering Drawing for Geneva Driving Wheel

Engineering Drawing for Candy Dispenser Lever





ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	Genevabaseplate	Base for Geneva drive and dispenser	1
2	Geneva2	Geneva Driving Wheel	1
3	Geneva1	Geneva Drien Wheel	1
4	93897A264	Black 1/4"" dia, 1/2" shoulder screw	2
5	92141A029	1/4" steel washers	4
6	90480A011	10-24 nuts	14
7	DispenserLever	Lever to Hold and Drop M&Ms	1
8	9654K515	Extension Spring	1
9	SidePanels	Symmetric Right and Left Panel	2
10	90272A197	#8-32 machine screws, 3/4" length	12
11	BackPanel	Backmost panel	1
12	BasePanel	Base Panel	1
13	TopSlidingPanel	Sliding panel with pattern cutouts	1
14	FrontInclinedPanel	Panel with buttons	1
15	UpperFrontPanel	Highest panel in the front	1
16	ScreenPanel	Panel with screen cutouts	1
17	SpringStopper	Used to hold extension spring in position and as models for buttons	10
18	DShaft	1/4" D-Shaft used to transfer rotary input	1
19	BottomFrontPanel	Lowest panel in the front with hole for D-Shaft	1
20	6389K627	Nylon Bearing for 1/4" dia	1
21	Knob	Rotated by user to actuate motion	1
22	DispensingHolder	Holds M&M's and drops them into the dispenser	1

CANDY DISPENSER

DESCRIPTION
ENTIRE CANDY DISPENSER ASSEMBLY

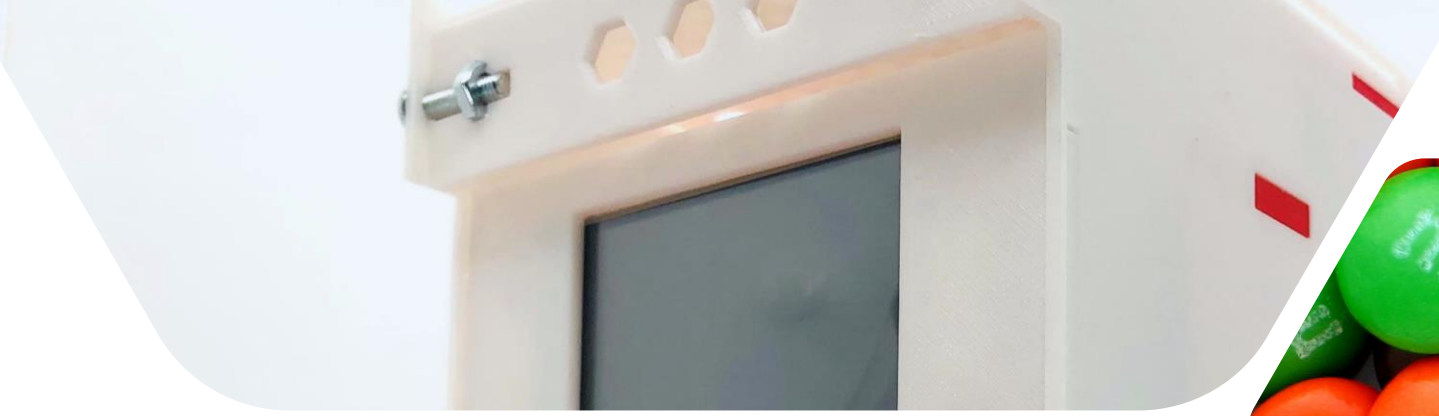
FILE NAME	SIZE	REV
GENEVAASSEMBLY	B	<X>
	SCALE: 1:4	
DRAWN BY: OMAR RAMOS ESCOTO	DATE: 9/20/20	SHEET 1 OF 1

DO NOT SCALE DRAWING

Assembly Exploded View Drawing with BOM

FINAL SOLIDWORKS ASSEMBLY

While designing this dispenser, I really wanted it to have some color that I would be excited to look at, so I decided to go for white PLA with red and black PLA accents. It worked out well and it was an interesting experience to see how each brand and color printed slightly differently. The knob provided to us for a class activity luckily matched the color scheme as well!



Final Prints

One major shift that happened in my design was the decision to change the user input. While I tested the design, I realized just how many constraints were presented by the bevel gears that I was using. They required a high level of precision that I did not feel comfortable with due to the expected inaccuracy from 3D printing gears with very small teeth. They did not only need to link perfectly with each other but remain at a very specific distance and angle of 120° and withstand wear and tear enough to avoid misalignment or skipping. This was not an approach that I felt comfortable taking and I thus changed the design to use a knob and D-Shaft instead which turned out to be much more intuitive, sturdy and allowed for faster printing since it removed the need to print those gears. In the end, the printing time required for the whole assembly totaled around 50 hours without counting reprints!

Reflection

This was an amazing learning experience in a myriad of ways. I learned many new things about CAD, especially about drawings, which I did not know anything about, but also about making decorative patterns, designing with degrees of freedom in mind and in general making a big step from designing without functional constrains in the logo project to planning designs around stock components, reliability and user experience for this project. The fact that I ended up with an “arcade machine” dispenser is something I am especially proud of because it is ultimately what excites me about making things: having a random idea and just making it happen.

As with any other process, I learned the most out of the challenges I encountered but also got to avoid many based on what I learned from the logo project. My print times were very high, but they rarely messed up because I learned from the first project how to check for tangling in the filament wheel and how to use adhesion and supports to avoid curling, which was essential for printing some of the big pieces I had to print this time. I have now also learned about how to set up multiple prints at once correctly, how to customize supports, and that not all PLAs are created equal. I experimented with two new colors from different brands and realized that what made a tight fight for one filament was a loose fit for the other one, which was a very valuable lesson that I will keep in mind from now on when testing fits. And lastly, I learned to plan out color schemes better so that my next arcade machine doesn’t look like it works at In-N-Out.

Next Steps

At the moment, the arcade machine has a 2.8" TFT touchscreen mounted, which I am very excited to work on during the break. I have everything I need to make this into a real arcade machine that can play all kinds of retro games through a raspberry pi, which was something I planned for but unfortunately did not have enough time to execute. However, I left space inside for all these components so I will be taking the next steps of putting this circuit together and printing adequate space for buttons using the lessons I just learned. From starting the quarter with absolutely no experience designing anything to being at a point where I am translating ideas to sketches to virtual models to physical prints that interact with stock components and electronics is the most inspiring way to end the quarter and is the biggest lesson I will take from this project: that I am capable of making ideas that excite me come true.