Iris Aperture Cup Holder

IB Design Technology SL Internal Assessment

Candidate ID: 050086-0023

Word Count: 1,997

Criterion A:

Problem Statement:

Car cup holders are typically either too big for smaller containers or too small for larger containers. When placing a small can in a large cup holder, one runs the risk of the can spilling or moving because of the lack of security, as shown in Figure 3. On the other hand, a large water bottle does not fit into many car cup holders, such as in Figure 4. According to primary research (displayed in Figure 5), 80% of people surveyed have experienced a bottle being too large for their car cup holder. Additionally, Figure 1 shows that some car cup holders are shallow and lack support, which leads to taller water bottles tipping over while the car is in motion. As shown in Figure 2, existing adjustable cup holders may involve claw-like parts that insecurely hold the container. These types of cup holders are often very weak structurally, especially for heavier containers, and may not fit large bottles. Containers that are able to fit in the standard car cup holder may be difficult or inconvenient to access for many drivers or passengers. Furthermore, cups that are placed on a table or other flat surface can spill easily due to the small base and lightweightedness of many bottles. According to primary research (shown in Figure 6), 100% of people surveyed have experienced a beverage container spilling over after it was placed on a flat surface. Cups are usually set directly onto surfaces, which is not a secure method of leaving a beverage on a table. Therefore, the problems that need to be addressed are the prevalence of nonadjustable cup holders in vehicles and the insecurity of placing containers on surfaces without support to protect from spillage.

Figure 1. (Bailey)

Figure 2. (“SnapIt”)

Figure 3.

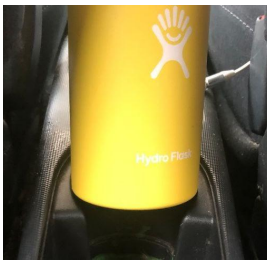


Figure 4.

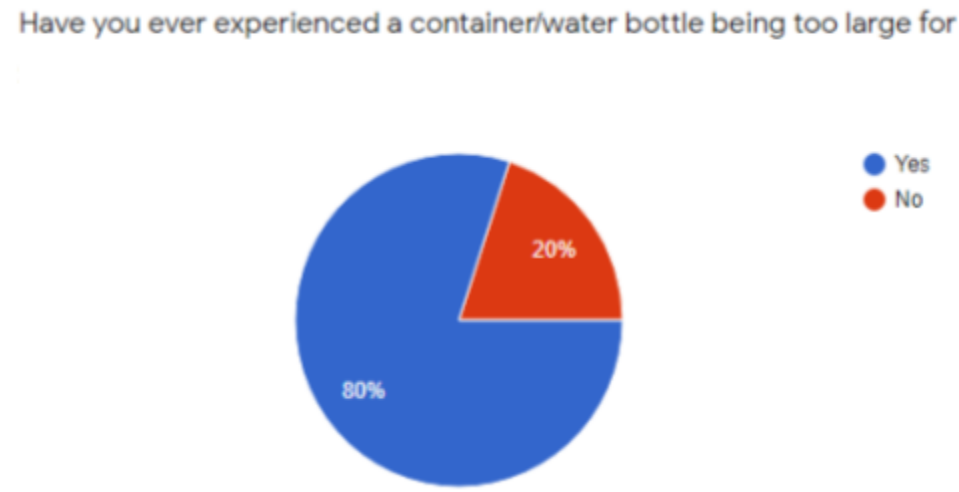


Figure 5.

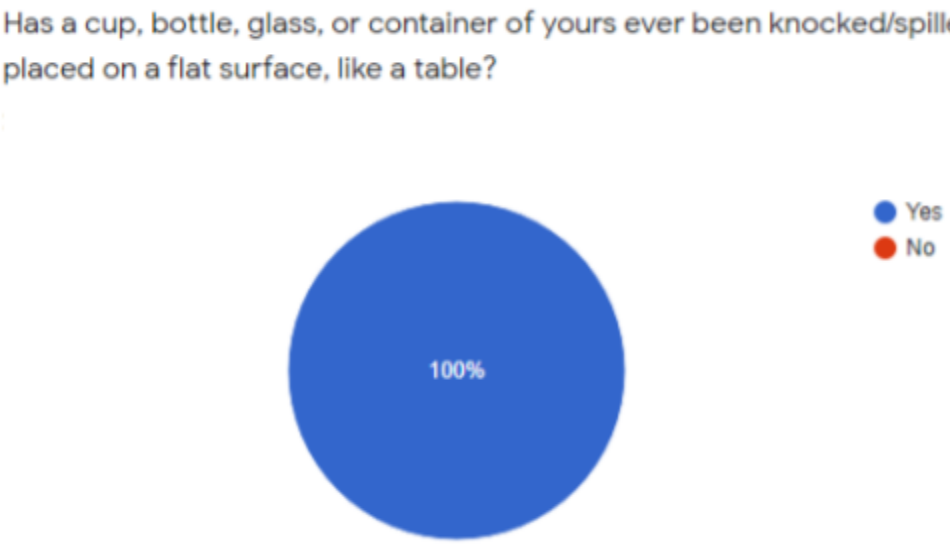


Figure 6.

Design Brief:

The expected outcome is an adjustable cup holder that allows for containers of a variety of sizes to fit securely in any car or on any table. According to primary research (shown in Figure 7), 100% of people surveyed would find it useful to have an adjustable cup holder that would accommodate a variety of bottle sizes and could be placed in a car's cup holder or on flat surfaces. Cars generally have universal cup holders that do not vary greatly between different makes or models, so it is important that the cup holder is compatible with the standard size car cup holder while also being adjustable to both smaller and larger sizes. There is a wide range of sizes for reusable water bottles, beverage containers, and cans, so it is essential that the cup holder is adjustable beyond multiple specific sizes in order to ensure a secure hold. Depth is an important factor because containers need to be able to fit securely without tipping over. A depth

that is a significant portion of the height of most common containers would be beneficial in terms of accessibility and stability. Because a notable aspect of the problem is cups being insecure if they are simply left on any surface, a broad requirement would be a detachable standard-sized cylinder, so that the product can have multiple uses.

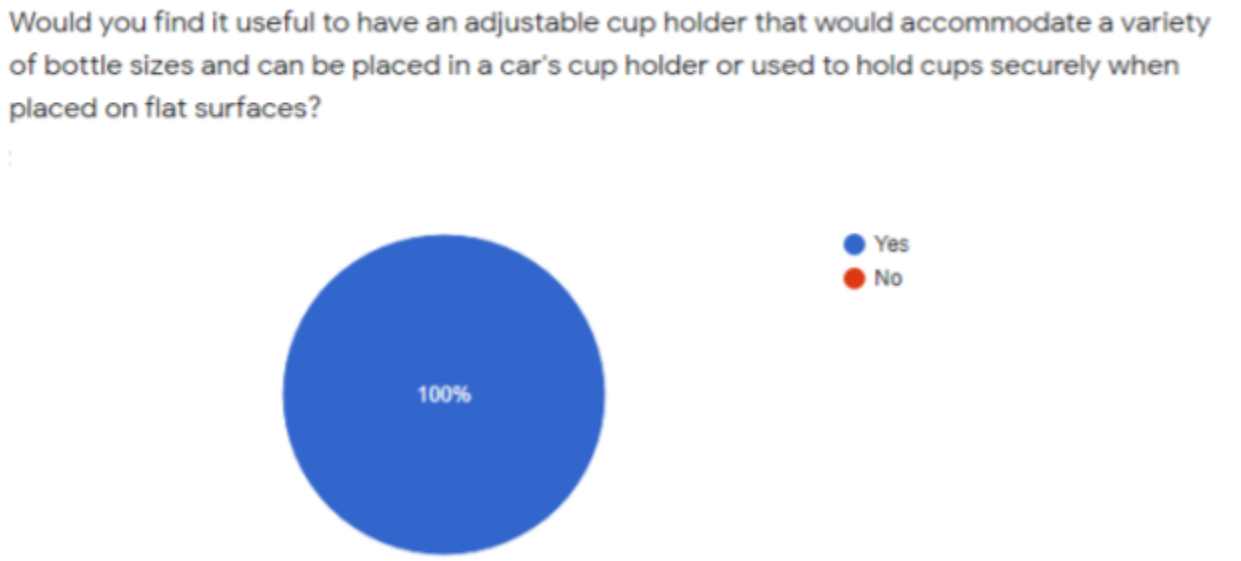


Figure 7.

Design Specifications:

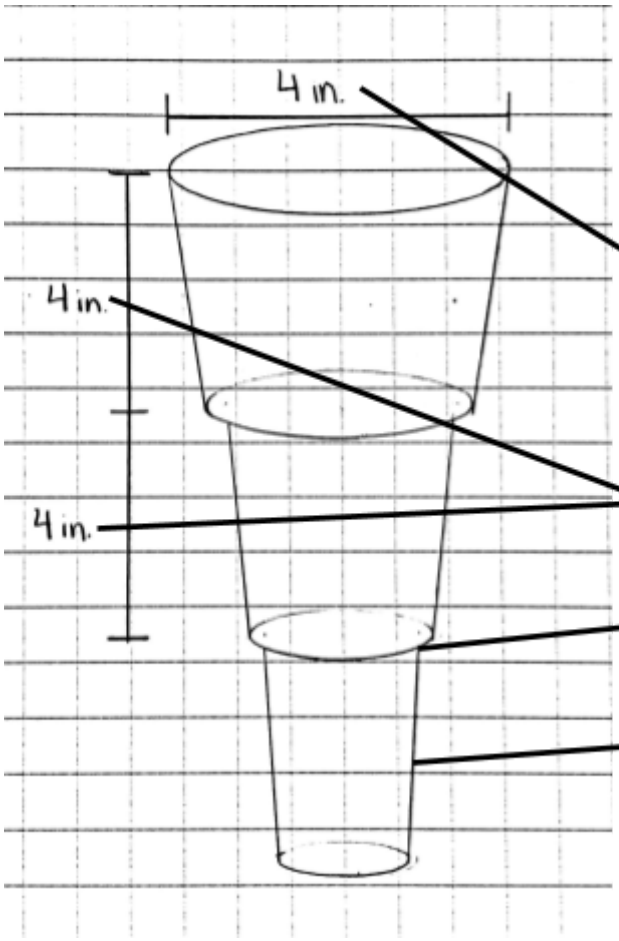
1. Material Selection and Aesthetics	The material selection would be based on aesthetics, availability, and strength, as most materials would be able to perform all of the functions that the product requires. Ideally, the product should be made out of an eco-friendly material, such as reclaimed wood or another sustainable wood. Wood is a resilient material that would allow for a simple design and neutral colors that combine well with the interiors of cars or the materials of most tables. The wood may be stained a variety of colors to suit user preferences. The sealer used on the wood should also be environmentally-friendly and non-toxic because the product may come in contact with beverages or young children. Additionally, Velcro strips and the standard-sized cylinder, which would be made out of the same material as the rest of the product for consistency in terms of appearance and construction, would be necessary materials because they would enable the product to be used both in the car and in the home on flat surfaces. The Velcro strips would make the cup easily detachable, allowing for a quick transition between the multiple uses of the product.
2. Target audience	The target audience would be car owners, drivers, and frequent passengers, who often purchase or consume beverages in their cars.

	These beverages may be in containers that vary in size, either being too small or too large for their car cup holders. Those who bring a water bottle with them when they are exercising or travelling from place to place and those who reach for their water bottle or beverage container while in their car may make up a portion of the target audience. Additionally, the target audience would include those who enjoy leisure time on the couch or in chairs, while leaving their beverage on a table, where it risks being spilled.
3. Function	The function of the product would include the ability to adjust it to the specific sizes of a variety of small or large bottles or cups. The product's function will include securely holding containers of any diameter or height while the car is in motion, as well as making beverage containers more readily accessible to passengers. A standard-sized cup would be detachable from the product, so that the product can easily fit into any car cup holder or simply be placed on a table. Therefore, the product should also be able to keep a cup or bottle from spilling, when it is placed on a flat surface, by holding it securely. The product must be portable, so that it may be transported between the car and the home.
4. Production constraints	The main production constraints are access to specific materials needed to make the product and the technology or automated machinery that is used in production. There is only going to be a certain amount of materials and technology accessible to me, so the amount of supplies and the available funds to purchase the materials will be a production constraint. Time and skill level are also potential production constraints because it will take a certain amount of time to assemble the product at my current ability in terms of skill and knowledge.
Size of product	The product should be approximately 4 inches in height to offer the container security and decrease the risk of bottles tipping over. Primary research has shown that the bottles or cups that people have experienced being too large for their car cup holder are all less than 4 inches in diameter; therefore, the center of the product, where the containers are placed, should be approximately 4 inches in diameter, so that larger bottles can fit securely. Moreover, the product should be approximately 6 inches in diameter in total, so that it can accommodate the many different sizes of beverage containers, as well as fit in the center console of many cars, where the cup holders are normally located.
Quantity	One of the product will be made using the materials listed above.

Criterion B:

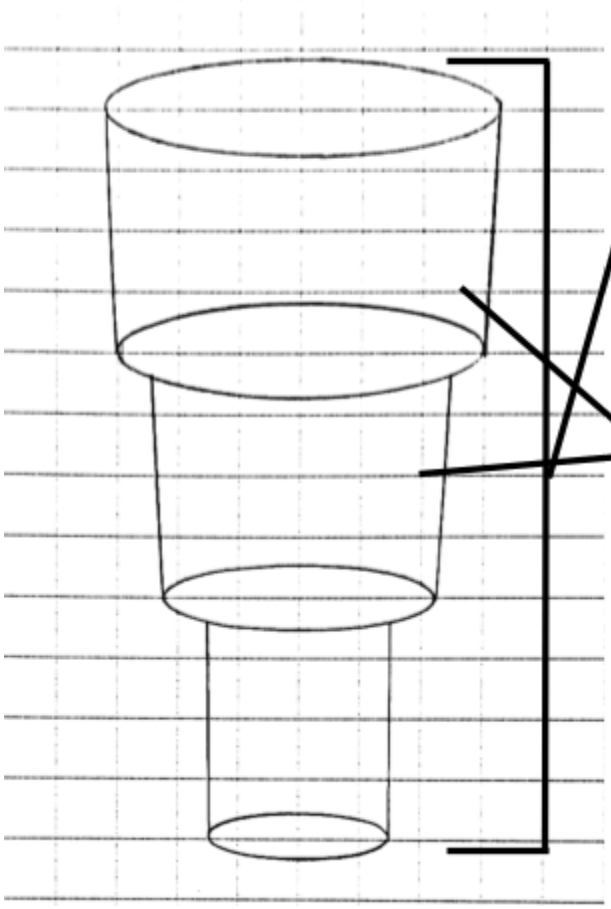
Initial Feasible Ideas:

1. Collapsible Cup Holder



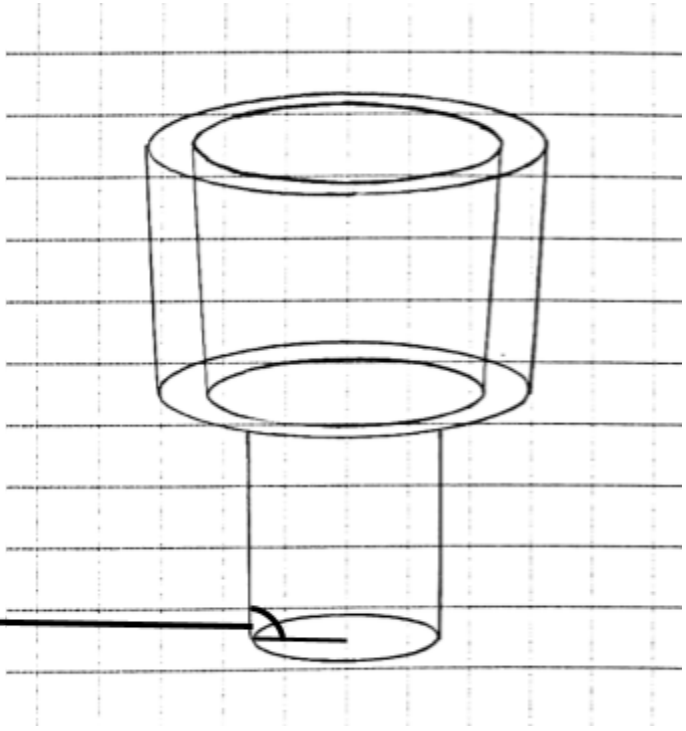
Annotations:

- Holds containers of common diameters larger than car cup holders
- 4” maximum diameter accommodates most common large bottles
- Total height: 10.25”
- 4” in height of collapsible cups prevents containers from tipping
- Velcro allows for use of the product on flat surfaces
- Standard-sized cup (2.25” in depth and 2.675” in diameter) allows for compatibility with most car models

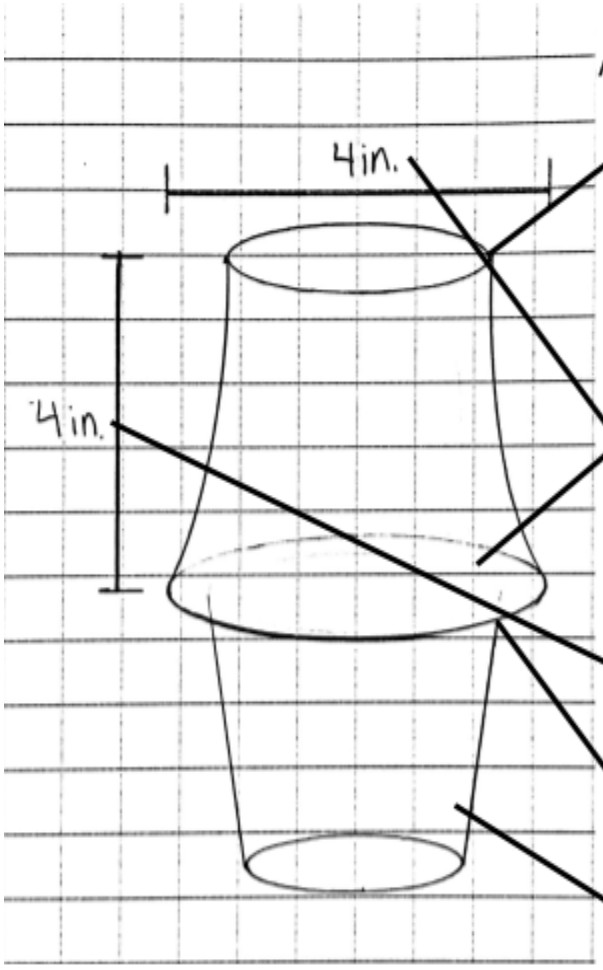


- May be too tall to fit in car console
- May interfere with driver or passenger's mobility or accessibility to areas of car
- Multiple levels of sizing
- Unstable at maximum height, due to small base, if on flat surface

- Only fits specific sizes; not continuously adjustable for range of diameters
- Will not accommodate containers that are smaller than cup holder
- 90 degree angle



2. Elastic Cup Holder

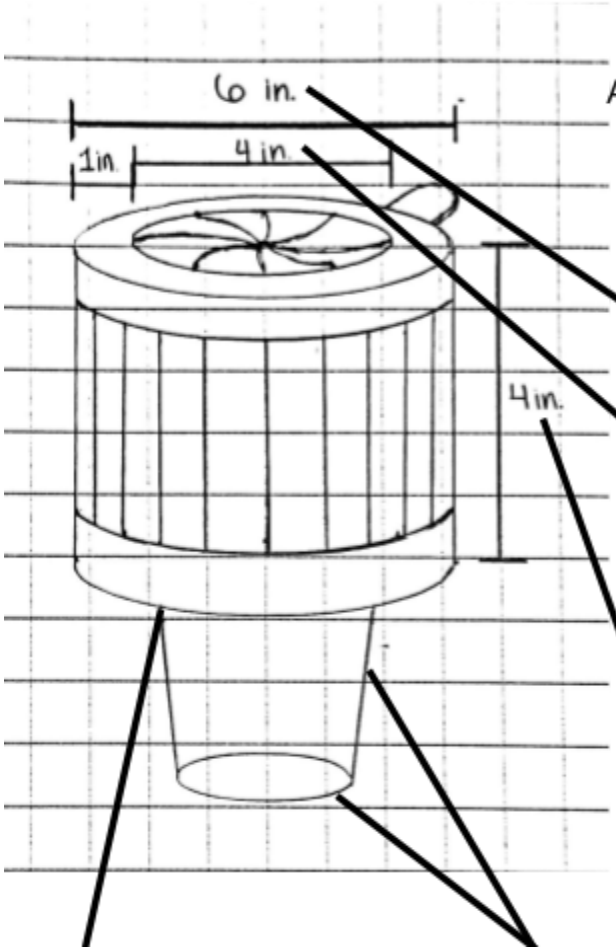


Annotations:

- Elastic needs to be stretched, so bottom of the container can fit through the opening and be placed on the base
- Holds containers that are larger and smaller than car cup holder
- Maximum diameter is 4" to accommodate larger bottles
- Total height is 6.25" with the elastic being 4" in height
- Elastic section holds up to 4" in height to prevent containers from tipping over
- Velcro allows for use of product on flat surfaces
- Standard car cup holder allows for compatibility with most car models

- Base accommodates large containers, so small bottles might lack security, as bottom may move around on the base
- Difficult to get larger containers into elastic because it needs to be stretched

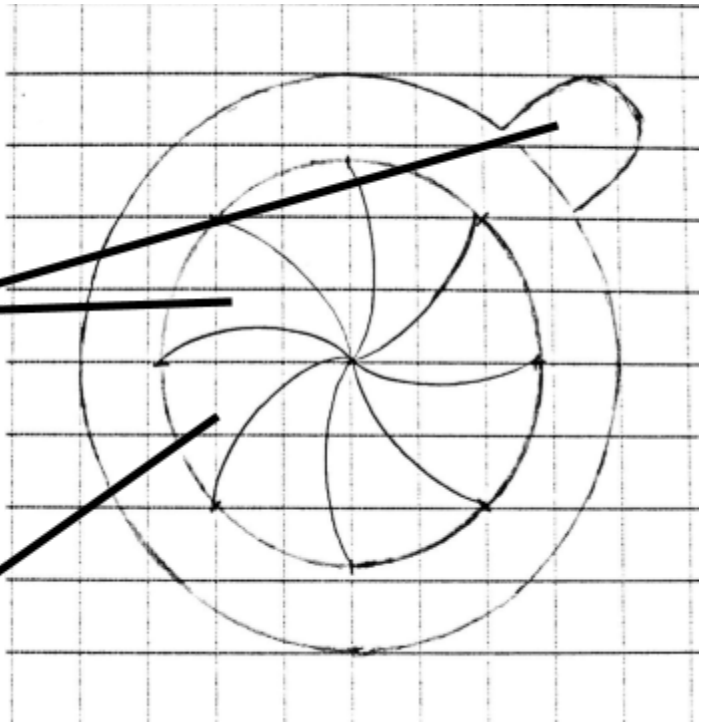
3. Iris Aperture Cup Holder



Annotations:

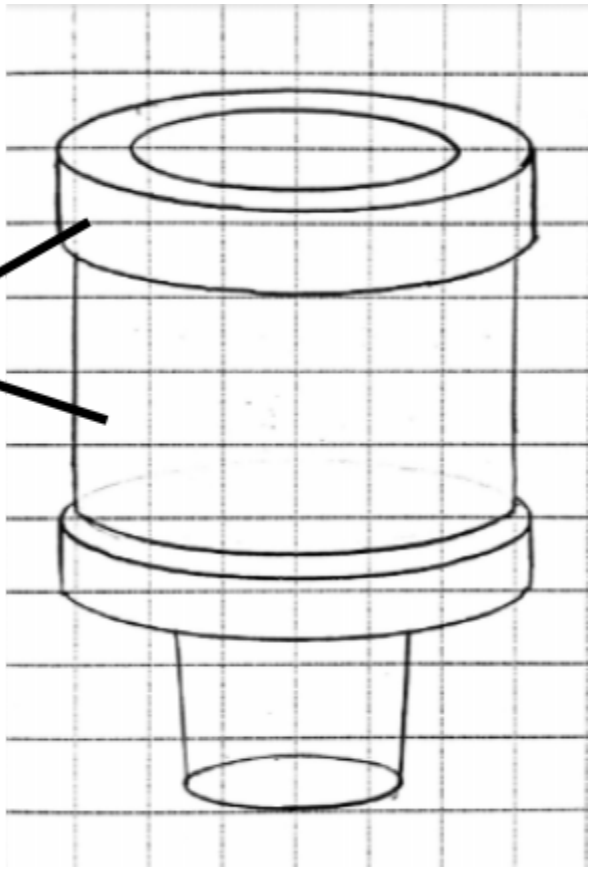
- Holds containers of all diameters smaller or larger than cup holder up to maximum of 4” in diameter
- 6” in diameter allows for it to fit in center consoles, where cup holders are located
- 4” for maximum diameter accommodates most common large bottles
- Total height: 6.25”
- 4” in height prevents containers from tipping while the car is in motion
- Velcro attachment allows for use of product on flat surfaces
- Standard car cup holder allows for compatibility with most car models

- Tab and arms allow for adjustability within range of diameters and security in their hold of the container



- 8 arms that open and close the center completely

- Slightly smaller diameter of the center portion allows for easier grip, if not held by the cylinder attached to the bottom

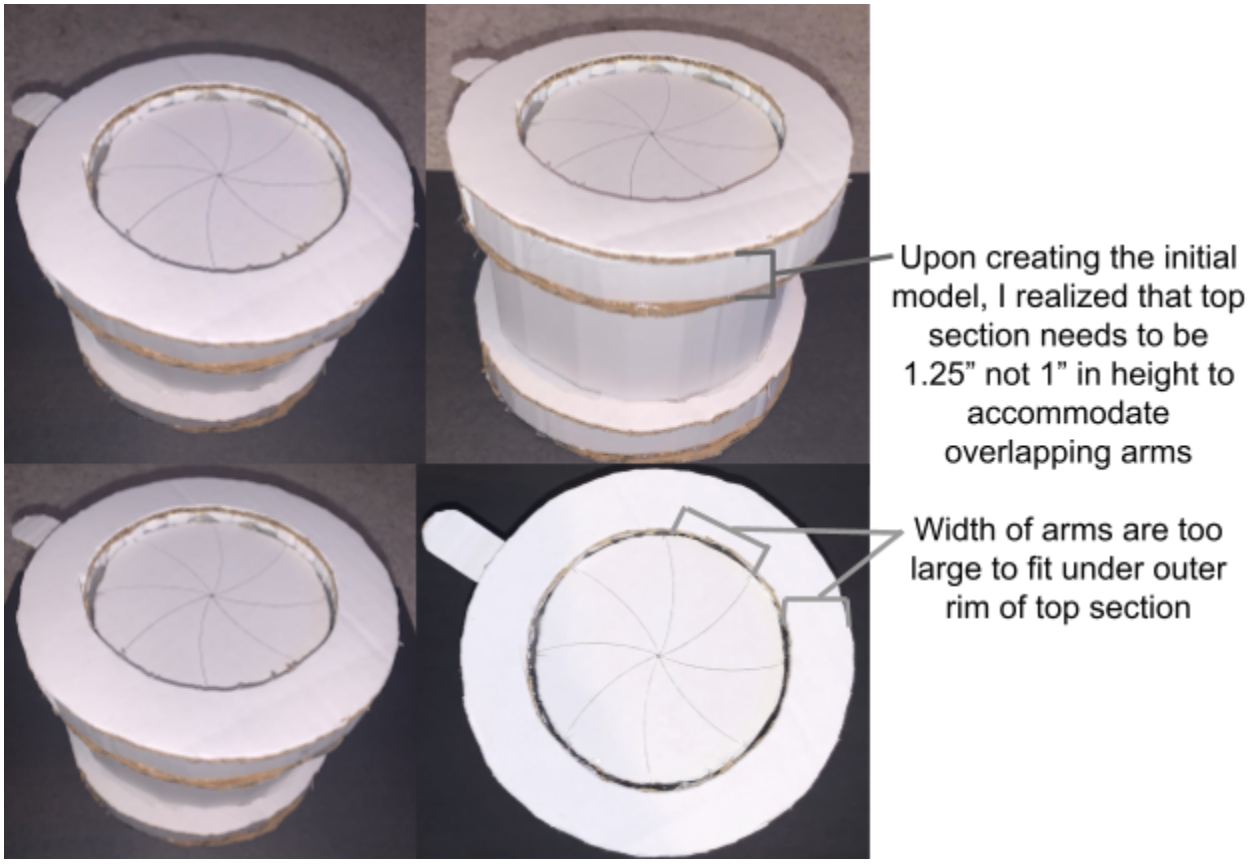


Design Matrix						
Design Decisions	Design Elements					
	Adjustability	Security	Stability	Accessibility	Materials**	Total
1. Iris Aperture Cup Holder	5	5	4	4	5	23
2. Collapsible Cup Holder	2	2	1	5	1	11
3. Elastic Cup Holder	3	3	4	1	3	14

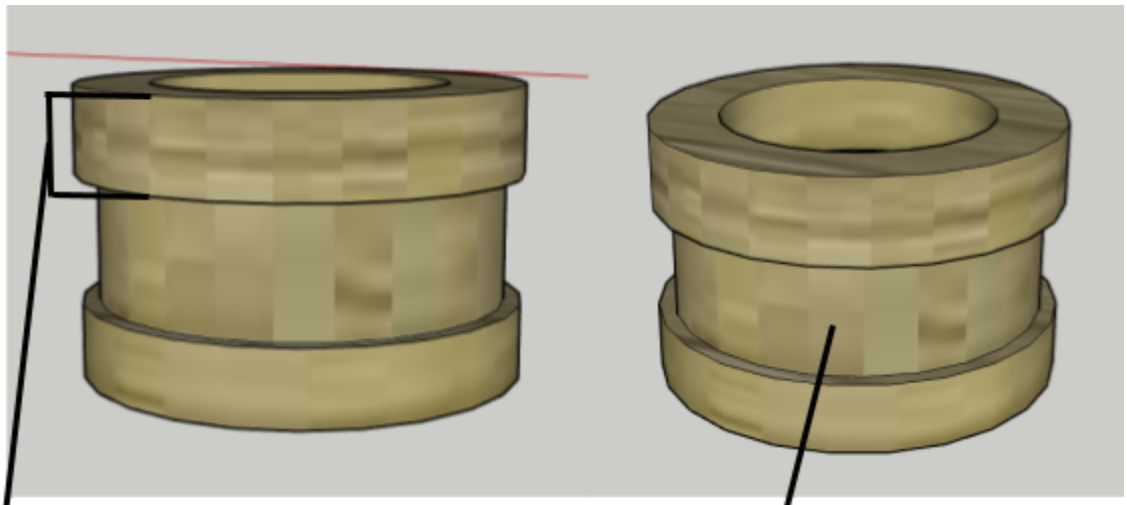
**Materials refers to both the availability and sustainability of the materials used in the design.

Key:
1 = The design does not meet the specification.
2 = The design minimally meets the specification.
3 = The design somewhat meets the specification.
4 = The design meets the specification.
5 = The design meets all aspects of the specification completely.

Initial Concept Model:



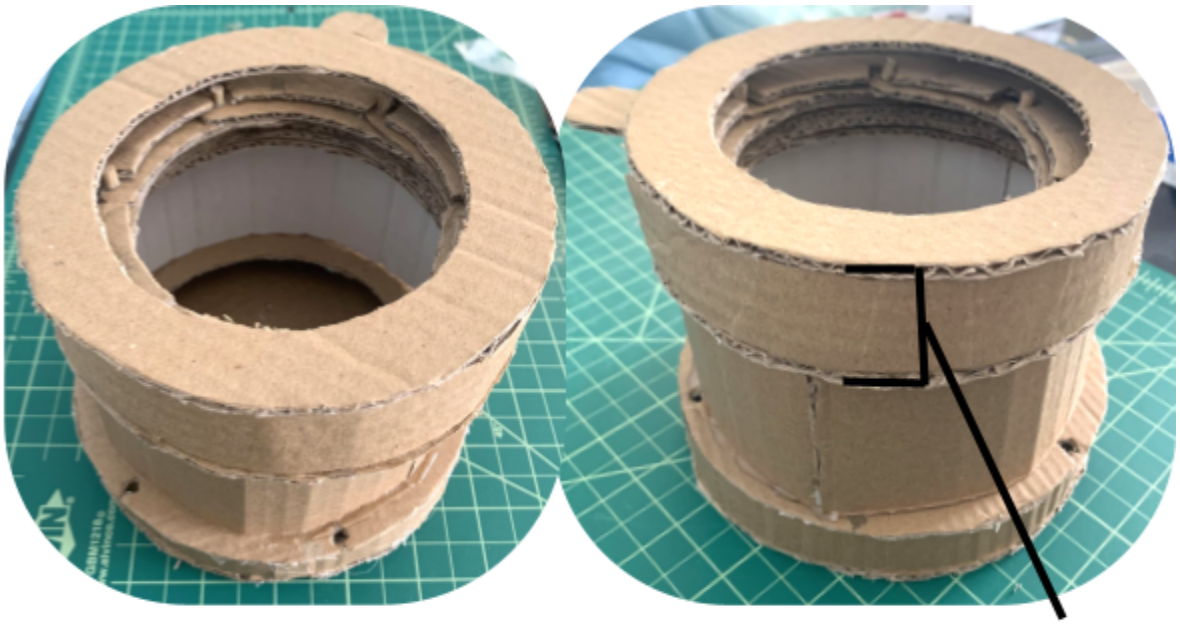
Virtual Model:



1.25” in height, so that each of the 6 arms can rotate freely on top of one another

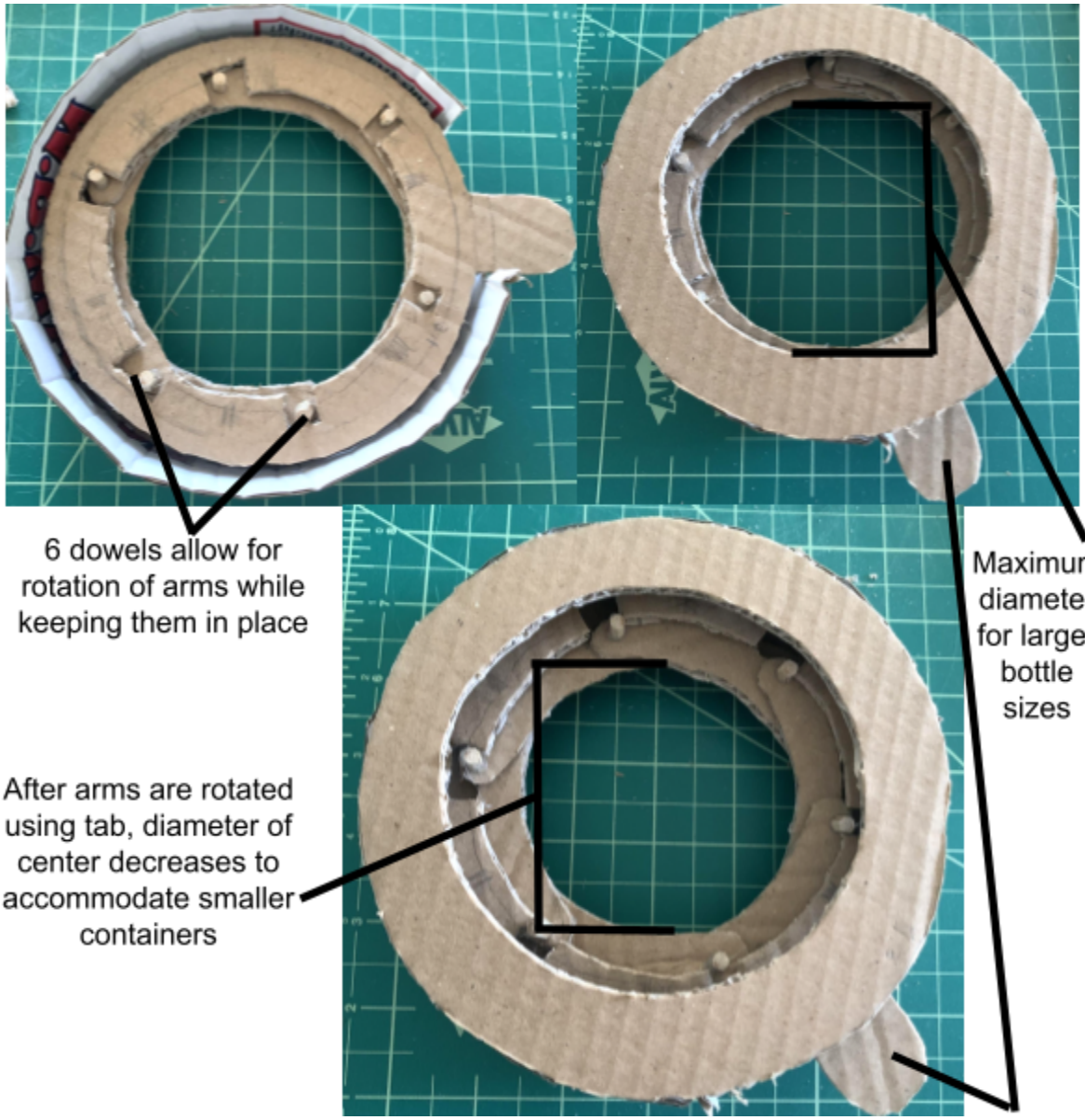
Models neutral color aesthetic and wooden material

Updated Concept Model:



Height allows for placement in center consoles, where cup holders are located

1.25” in height, so layers of arms can fit without interference

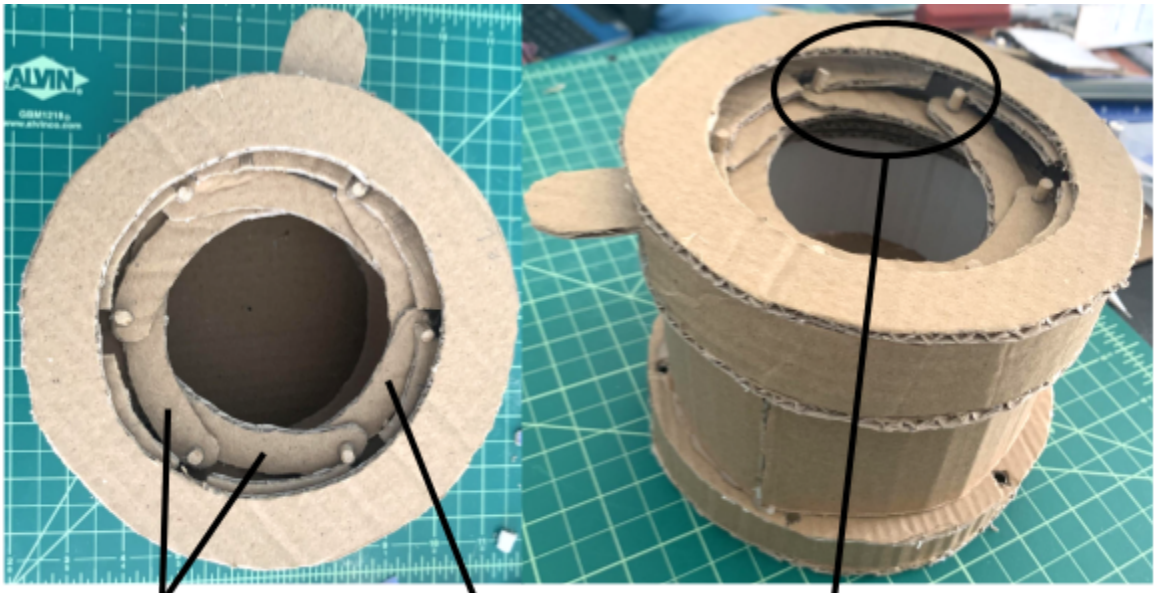


6 dowels allow for rotation of arms while keeping them in place

Maximum diameter for larger bottle sizes

After arms are rotated using tab, diameter of center decreases to accommodate smaller containers

Tab can be moved horizontally to rotate arms closer or farther and change diameter of center, depending on container size



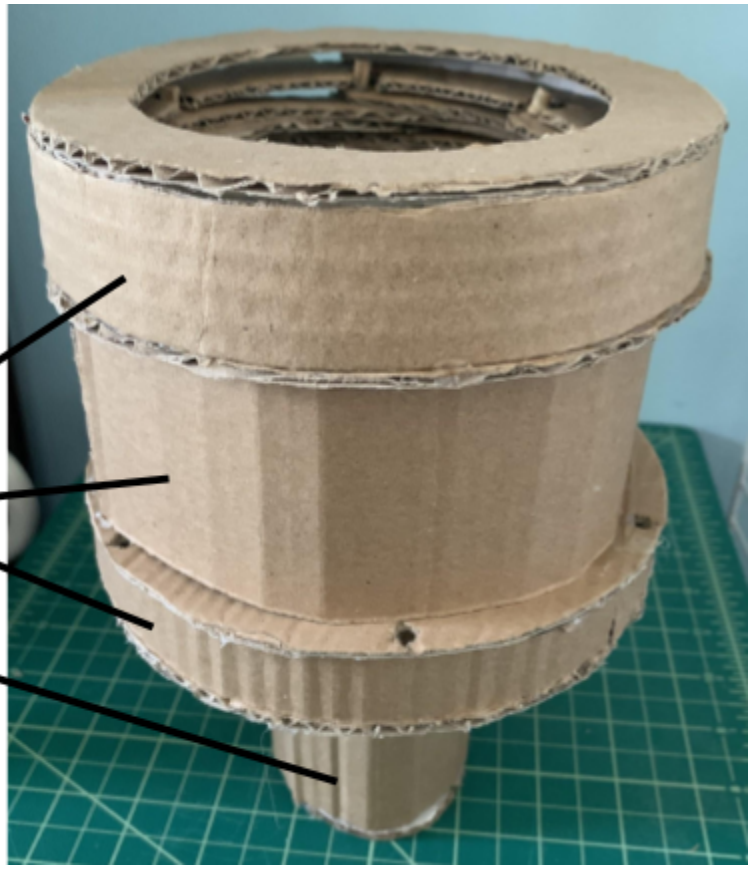
Rotated arms encircle the container in the center to keep it secure

Layered arms, and dowels fit in slots to allow for rotation of arms

Thinner arms that can fit under outer rim

Cup holder contains 4 sections that make up the frame:

- aperture section
- main body
- bottom section
- standard-sized cylinder



Final Product Selection Justification:

I chose to pursue initial idea 3, the iris aperture cup holder, because the design effectively meets more of the specifications in comparison to the other initial ideas. The design has complete adjustability within a reasonable range of diameters, allowing for both small and large bottles to fit within the product, whereas the other designs would be limited in the size of containers that they could accommodate. The security of the container being held by the product and the stability of the iris aperture cup holder, due to the minimized height of the design, are important considerations in terms of its functionality. The six separate arms that move together would keep the container secure in the center of the cup holder, and the main body of the product being merely 4” in height would keep it from being unstable when placed in a car’s cup holder or on a flat surface. The size of the iris aperture cup holder, in comparison to the sizes of the other initial ideas in terms of height and diameter, is much more suitable for being placed in the center console of a car and allows the product to more effectively meet the design specifications. Furthermore, the container within the cup holder would be easily accessible for passengers with this idea, as the aperture arms would be adjusted to the exact size of the bottle and can simply be adjusted for removal by using the tab and having the arms move farther apart from one another, whereas taut elastic would make it much more difficult to remove the container. Initial idea 3 can easily be produced using materials that are both available and sustainable, as well. For these reasons, I decided to develop initial idea 3, the iris aperture cup holder.

Criterion C:

Materials:

(“Bamboo Lumber”)

Bamboo Wood:

Properties:

The tensile strength of bamboo plywood is significantly stronger than that of conventional construction-grade wood. Bamboo wood is stronger than steel and maple wood, in terms of tensile strength, while also being much lighter. Bamboo is lightweight, which will allow the product to be easily held or transported when necessary. It is eco-friendly and often blonde in color, meaning the wood can be stained a variety of colors to satisfy user preferences. Bamboo wood also resists shrinking and swelling regardless of the container’s temperature, possible condensation, or varying external temperatures.

Bamboo Dowels:

Properties:

Bamboo dowels are eco-friendly and have excellent strength and durability. They are available in a diameter of 0.2 in., so they would fit easily through the holes in the base ring and the slots in the adjustability tab.

(“Bamboo Wood”)

Velcro strips:

Properties:

(“Hook”)

Hook-and-loop fasteners can be used for temporary attachment, which would allow the standard-sized cylinder to be detached from the holder for use on a flat surface.

Manufacturing Techniques:

A laser cutter would be used to cut out each of the bamboo wood parts that make up the mechanism, including the aperture mount, cover, arms, and base mount because laser cutting the wood that is 0.25” in height would be the most efficient way to mass produce these pieces. Laser cutting is a subtractive cutting technique that utilizes automated CNC and results in high accuracy, high quality cuts, and fine details. The same large sheets of wood would be used for these parts, and CAD software would be used to create templates for each piece of the product, allowing it to be commercially produced quickly and consistently.

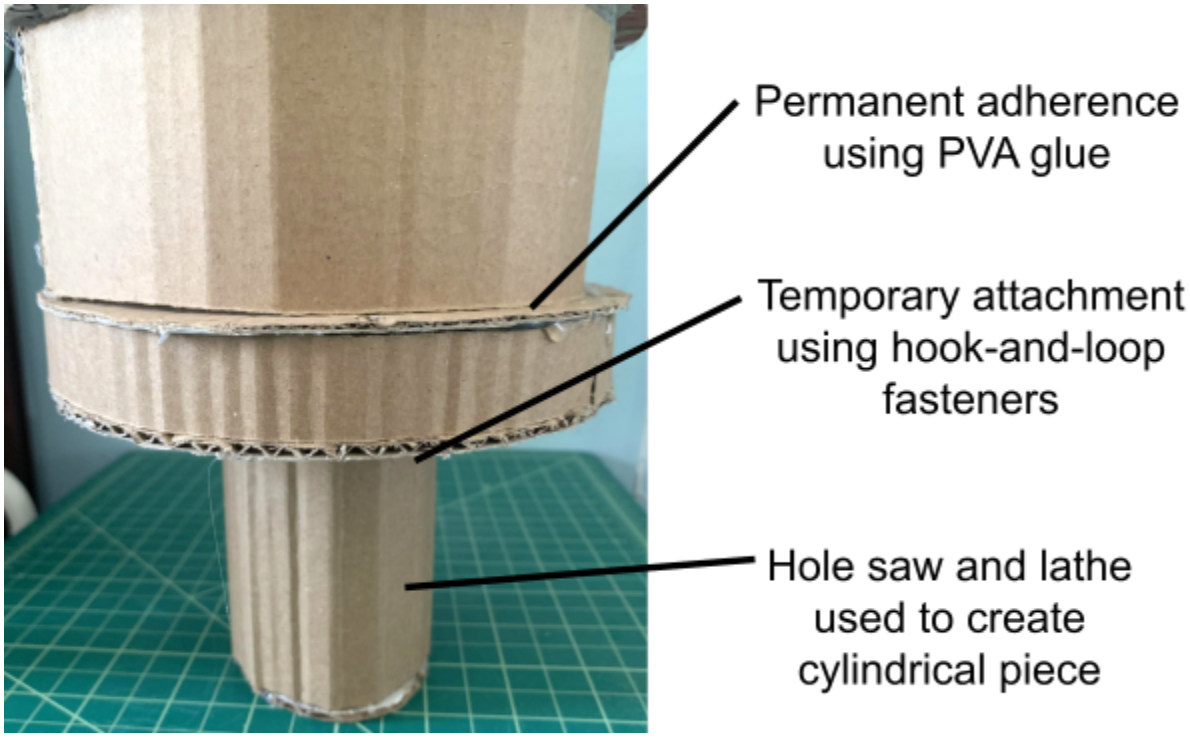
An automated jigsaw is a subtractive cutting tool that will be used to cut out the base outer rim, aperture outer rim, and main body of the cup holder. A hole saw will be used to cut out the centers of each to create the opening for the container because the height of the bamboo wood being used for this piece would be too large for laser cutting. These saws can cleanly and efficiently cut through wood of greater thicknesses. A hole saw would be used to create a perfectly circular opening in the center of these pieces using a single cut.

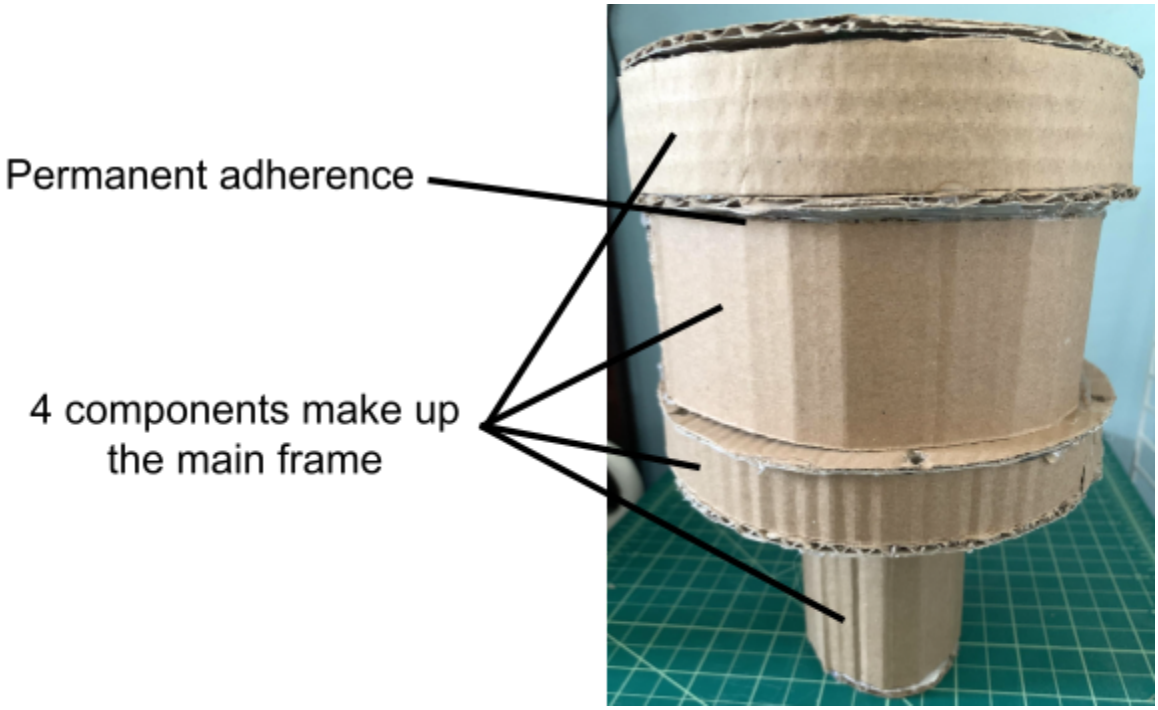
The cylinders that are cut out from the main body will be trimmed down to have a diameter of 2.5” using an automatic lathe. This subtractive cutting technique would allow the standard-sized cylinder to fit easily into a car cup holder by trimming it down to the appropriate diameter and would reduce the amount of scraps.

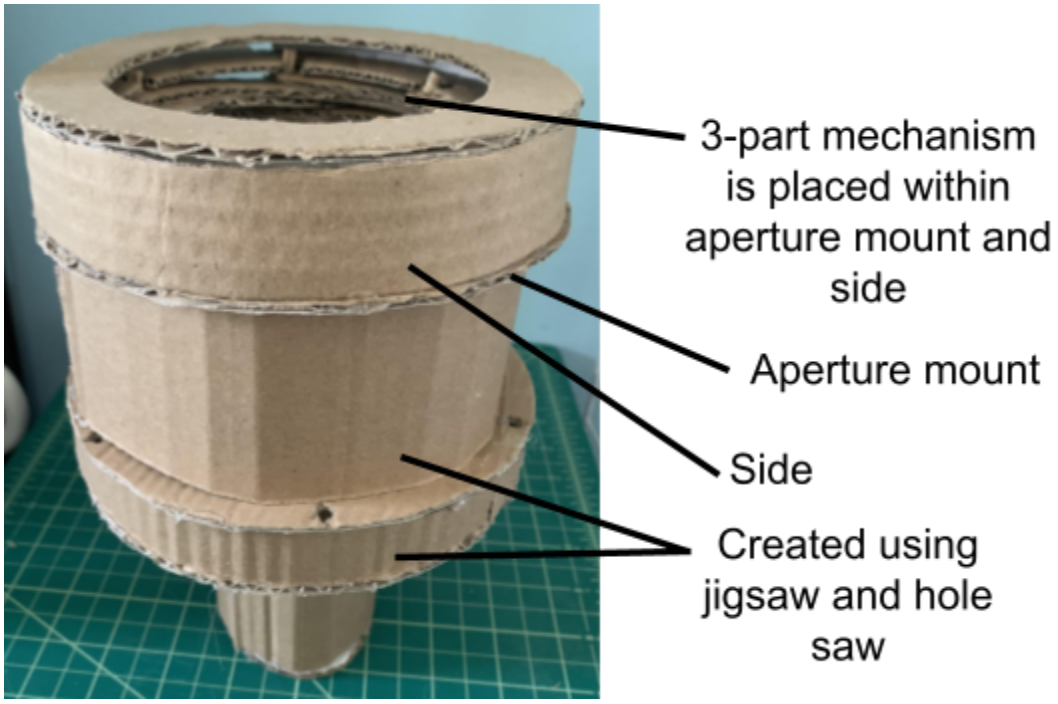
The bamboo dowels will be cut into pieces of 0.25” in length using an automated electric miter saw because the dowels can be cut through easily, and many pieces are needed for each product. These wooden dowel pieces will be adhered to either end of the laser-cut arms with one on either side, pointing in opposite directions, using PVA glue.

All of the wooden pieces will be sanded and sprayed with a water-based sealer. The main wooden pieces that make up the frame of the product, excluding the aperture cover and standard-sized cylinder, will then be adhered using PVA glue. The constructed mechanism will be inserted into the top portion of the product using an automated machine.

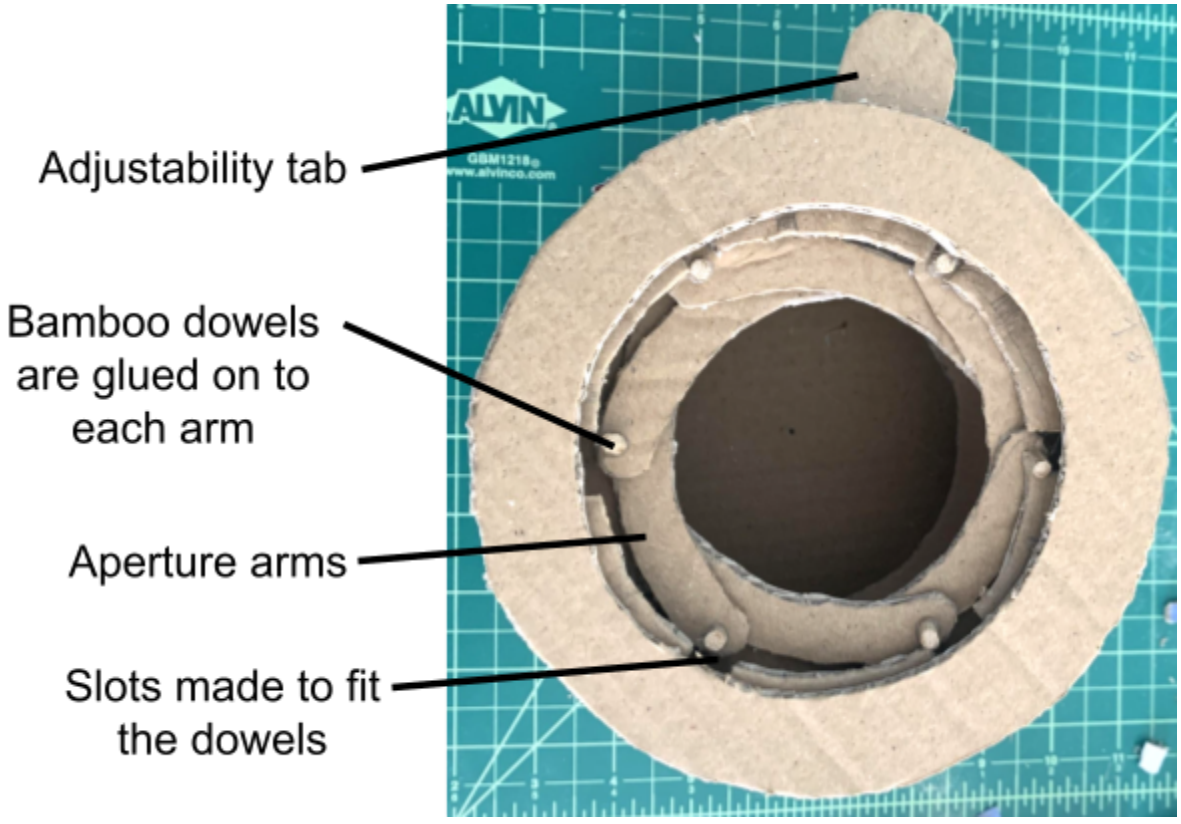
Design Proposal:



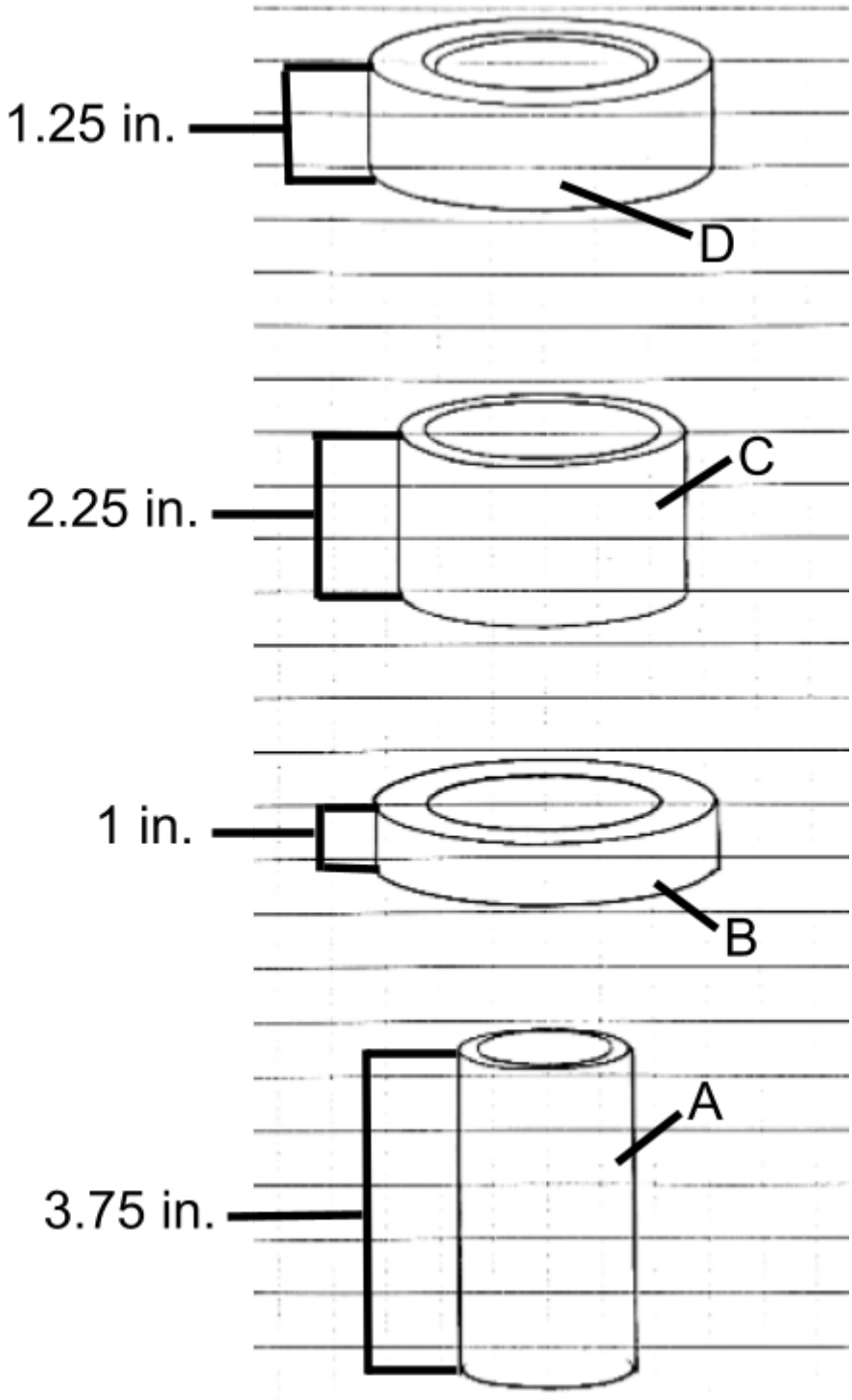

Permanent adherence
4 components make up the main frame

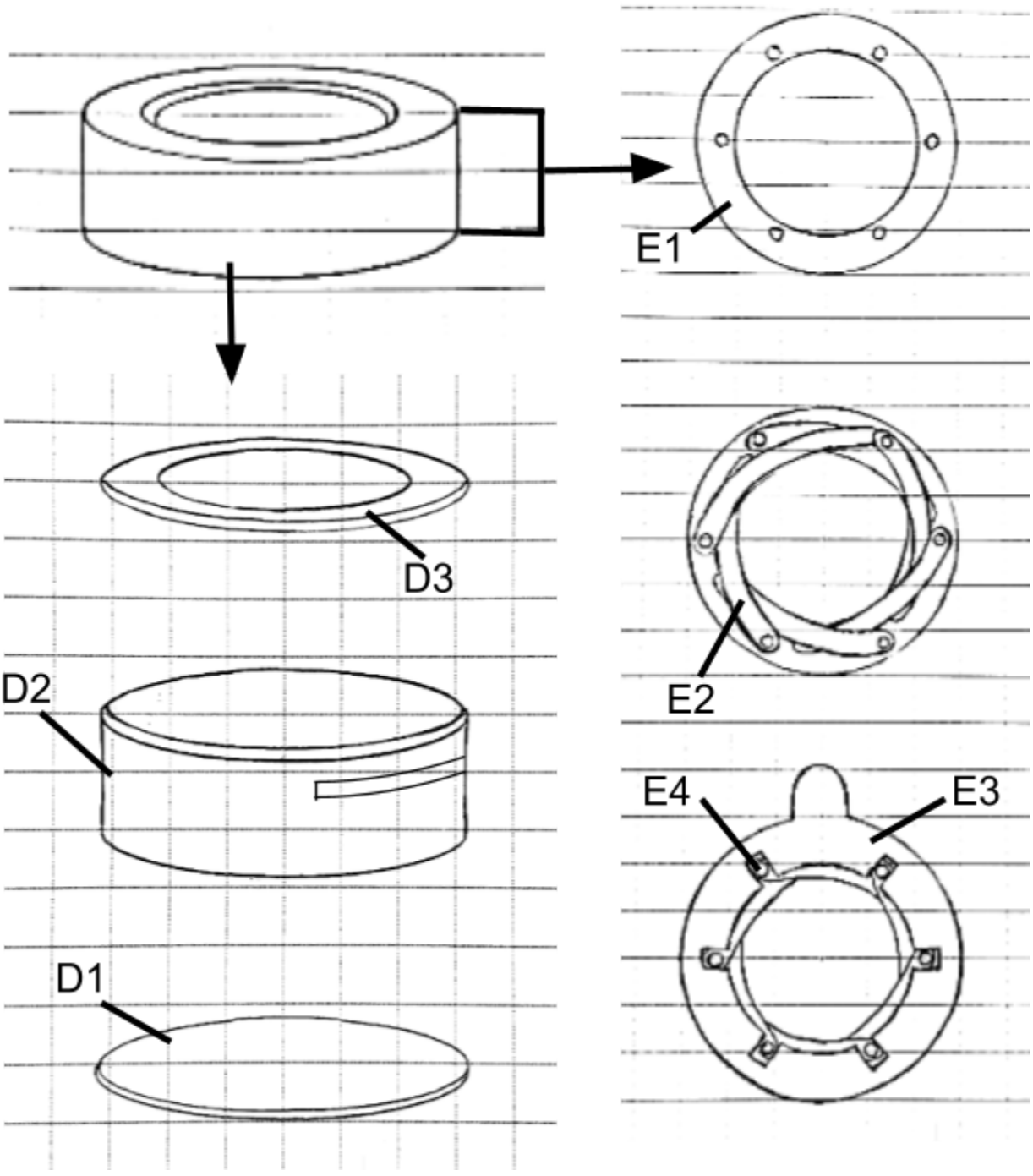

3-part mechanism is placed within aperture mount and side
Aperture mount
Side
Created using jigsaw and hole saw

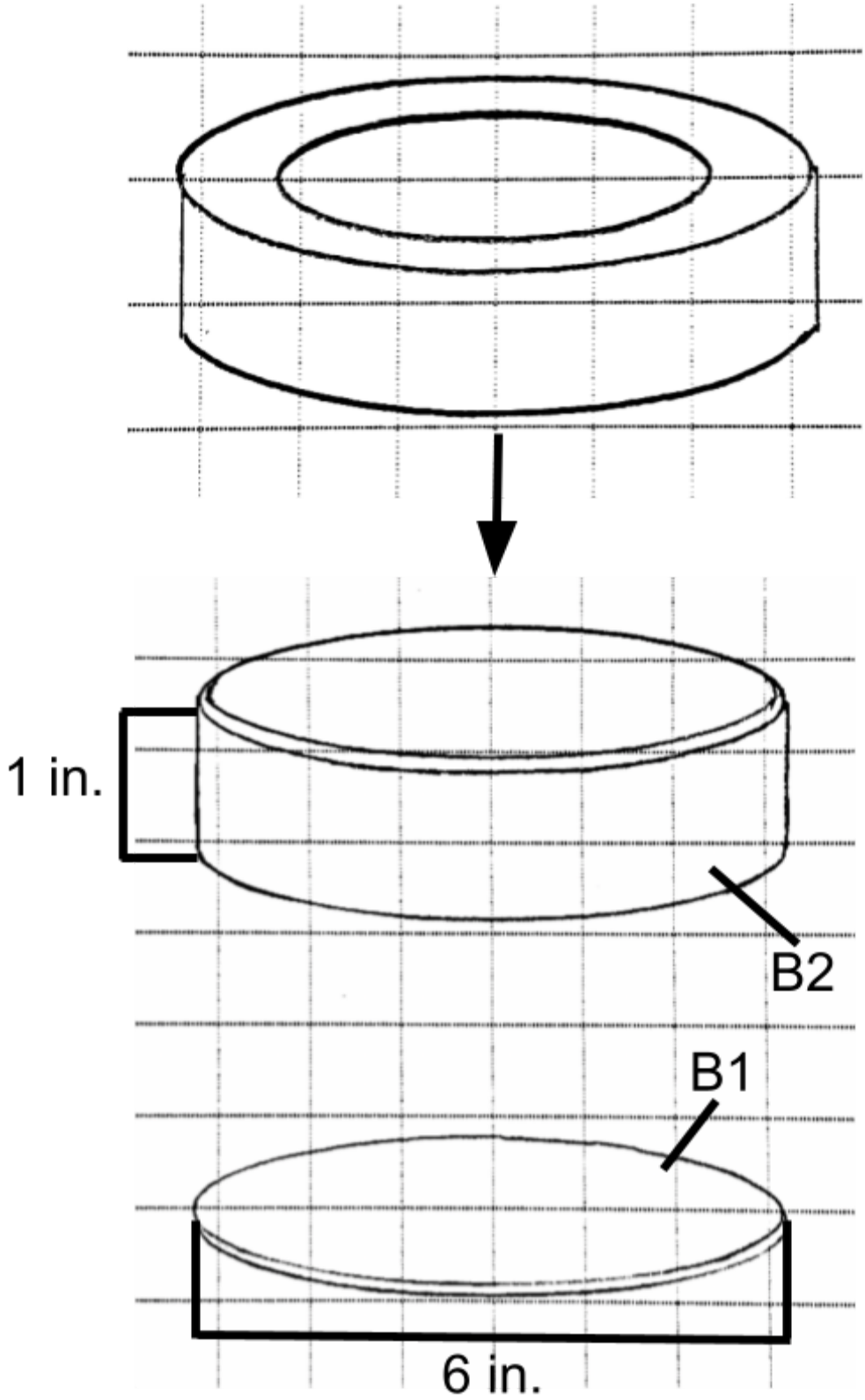

Laser cut
bamboo wood


Adjustability tab
Bamboo dowels
are glued on to
each arm
Aperture arms
Slots made to fit
the dowels

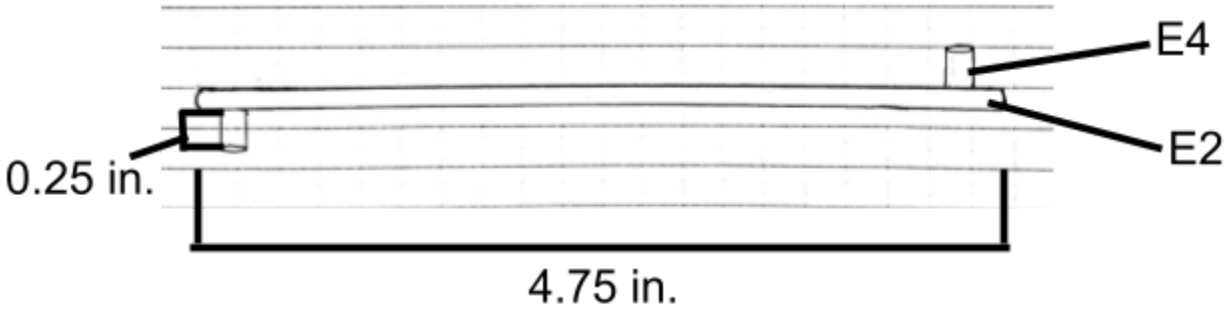
Parts and Assembly:



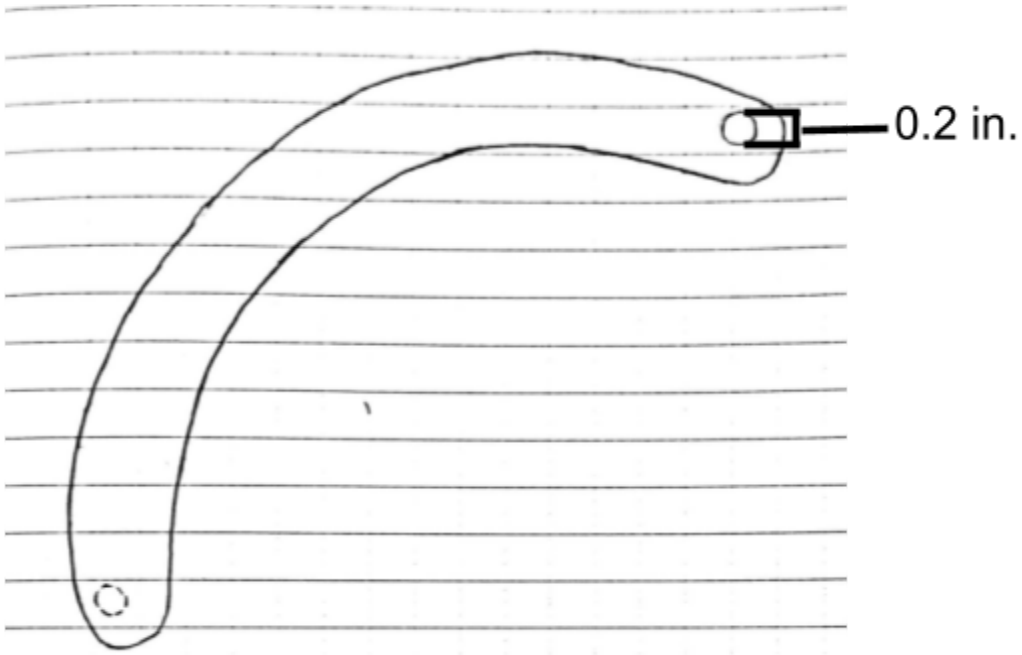

E1
D3
E2
D2
E4
E3
D1


1 in.
B2
B1
6 in.

Front View



Aerial View



Bill of Materials:

Piece	Description	Quantity	Material	Length	Diameter	Height	Thickness	Price
A	Standard-sized cylinder	1	Bamboo Lumber	-	2.5 in.	3.75 in.	-	$1.19
B1	Cup holder base	1		-	6 in.	0.25 in.	1 in.	$1.22
B2	Base outer rim	1		-	6 in.	1 in.	1 in.	$3.31
C	Main body	1		-	5.5 in.	2.25 in.	0.25 in.	$3.51
D1	Aperture mount	1		-	6 in.	0.25 in.	1 in.	$1.22
D2	Aperture outer rim	1		-	6 in.	1.25 in.	0.25 in.	$4.15
D3	Cover	1		-	6 in.	0.25 in.	1 in.	$1.22
E1	Base ring	1		-	6 in.	0.5 in.	1 in.	$1.93
E2	Arm	6		4.75 in.	-	0.25 in.	.5 in.	$0.49
E3	Adjustability tab	1		-	6 in.	0.25 in.	1 in.	$1.22
E4	Dowel	12	Bamboo dowels	-	.125 in.	0.25 in.	-	$0.06

Manufacturing:

Processes	Equipment	Scheduling	Quality Control
Collect materials	Bamboo wood, bamboo dowels, Velcro strips	1 hour	Inspect wood for cracks or splits
Laser cut wood	Bamboo wood, laser cutter	10 minutes	Inspect laser cut pieces for imperfections
Cut out large wooden pieces	Bamboo wood, jigsaw, hole saw	20 minutes	Inspect cut pieces for correct diameters and thicknesses
Turn cylinder	Bamboo wood, automatic lathe	20 minutes	Inspect diameter to ensure symmetry
Cut dowels	Bamboo dowels, automated electric miter saw	10 minutes	Inspect dowels for correct lengths
Sand all pieces	Sandpaper	1 hour	
Seal all pieces	Water-based sealer	1 hour	Ensure surfaces are dust-free
Glue dowels	Bamboo dowels, PVA glue	1 hour	
Assemble mechanism		1 hour	
Assemble frame	PVA glue, Velcro strips	40 minutes	
Test product		20 minutes	Inspect product for functionality

Gantt Chart:

Task - Strategy for Manufacture	1	2	3	4	5	6	7
Collect materials							
Laser cut plywood							
Cut out large wooden pieces							
Turn cylinder							
Cut dowels							
Sand all pieces							
Seal all pieces							
Glue dowels							
Assemble mechanism							
Assemble frame							
Test product							

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