

GNG2101 Deliverable B.2

Introduction to Product Development and Management

GNG 2101

May 14, 2023

Group Z13

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Abstract

The primary goal of this deliverable is to come up with a concept for our product. In order to do this, we will brainstorm as many ideas as possible for our creation. We will then describe each idea, provide a sketch for them, and evaluate them based on the target specifications we have. Next, we will move on to choosing the concept/concepts we deem promising and develop them further by either modifying them or integrating ideas into them from other concepts. This will be our global concept and will be useful for us when we are building a prototype in future deliverables. The final concept we have come up with is a cup holder with a bolt mechanism to tighten the device to the tray, with the cup holder either on top of the tray or at the side of the tray. The concepts have been designed in Solidworks to validate the ideas.

Table of Contents

Introduction	5
Concept Ideas	5
Justification of the Evaluation Process	12
Chosen concepts	13
Conclusion	16

List of Figures

Figure 1. CAD Model of the Mix of Concept 3 and 6

Figure 2. CAD Model of Concept 4

List of Tables

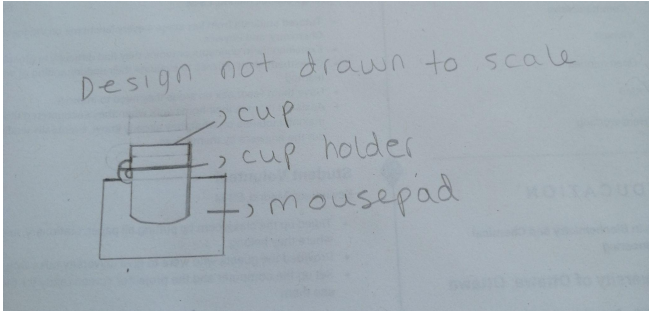
Table 1. Descriptions and Design Specifications of Different Concepts

Introduction

After understanding the client's needs and setting target specifications for them, our team moved on to the concept generation phase of product development. In this phase, we all activated our creative thinking skills to generate as many concept ideas as possible for the secure cup holder our client needs. The purpose of this was to help us combine all the strengths of these different concepts and come up with a new, more developed concept that we consider the best to be used for prototyping. Evaluating each concept is essential so that we can eliminate the cons of each concept to satisfy the client needs as well as to make a realistic prototype. This report will outline all of the concepts that were generated along with their description, their design specifications, their assembly, and their repairability. It will also delve into the evaluation process used for choosing the best concepts, as well as descriptions and explanations of the two final concepts we will be developing prototypes for in the future.

Concept Ideas

Table 1. Descriptions and Design Specifications of Different Concepts

<p>Concept 1.</p> <p><u>Description:</u></p> <p>A cup holder which is very accurate in size. It must be the same shape as the cup and only slightly larger than it so that the cup just fits in. The only difference will be the height of the cup holder (lower than the height of $\frac{1}{3}$ of the cup exactly). The base of the cup holder is attached to a small mousepad platform slightly larger than the cup holder.</p> <p><u>Design Specifications:</u></p>	 <p><u>How to Assemble:</u></p> <p>Cup is put into the cup holder. In order to assemble the cup holder onto the wheelchair tray, place the cup</p>
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1. The cup holder height and diameter can meet the target specifications because the cup holder is very similar to the cup.
2. The time to assemble the system will take longer than 15 seconds as taping takes quite a long time objectively. Hence, the target specifications in this area won't be met.
3. The total weight of the cup holder and the cup, the total height, and the total diameter can meet the target specifications.
4. Product is made out of sturdy and waterproof materials. For the same reason, the product will last forever unless damaged deliberately.
5. The product is easy to use because it doesn't have many components.

holder wherever you want on the tray, and tape the platform to the tray.

How to Repair:

If the mousepad ever gets detached from the cupholder, a new mousepad must be integrated into it. If the cup holder ever gets broken, a new one can be reprinted.

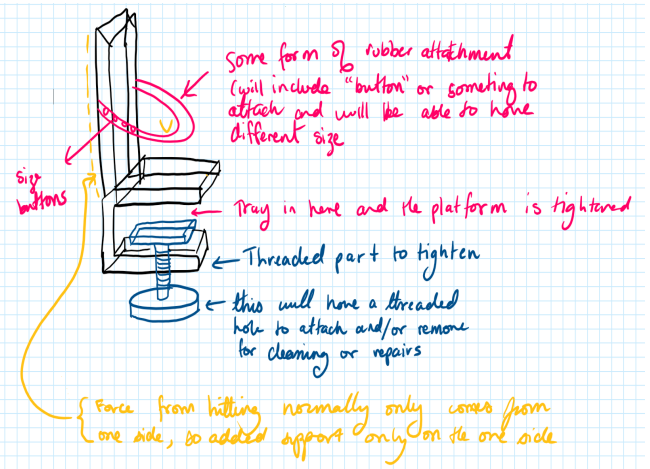
Concept 2.

Description:

The cup holder is attached to the tray by a slot and a clamping mechanism. The clam is tightened from underneath. To hold the cup in place, a support will be placed along the back of the cup and a rubber strap that can be set to different lengths will be used. If necessary, more than one strap can be added.

Design Specifications:

1. Three parts (Clamp, Strap, Cup Holder)
2. The weight will be roughly what is expected, as the cup holder and clamp will be made of PLA plastic.
3. Easy to repair as all parts will be 3D printable (except the rubber strap, which can be easily



How to Assemble:

The device will be pre assembled by the team before giving it to the customer. All the customer must do is place the cup holder on the tray with the tray in the opening and then tighten the clamp until the desired pressure is achieved. They must then secure the strap

purchased online)

4. The dimensions will be designed to fit the desired specifications (tailor made for the specific cup and tray) and the diameter can be changed by using a larger strap.
5. The cost will be minimal due to using a pre-existing 3D printer for the cup holder and the clamp. There will be a small cost for the rubber band, but that is also minimal as it can be purchased in bulk online.
6. The time to complete this design will depend on the shipping time of the rubber strap, as well as how quickly the CAD of the project can be designed and printed. A print of this size will take around 7 to 8 hours.

by using a button that will be attached to the cup holder.

How to Repair:

In order to repair the device. It will depend on the broken component. For the actual cup holder, a re-print must be done, and the other two pieces will be reattached. The same occurs for the clamp. The strap can be easily replaced by re printing and then re-threading the part onto the cup holder.

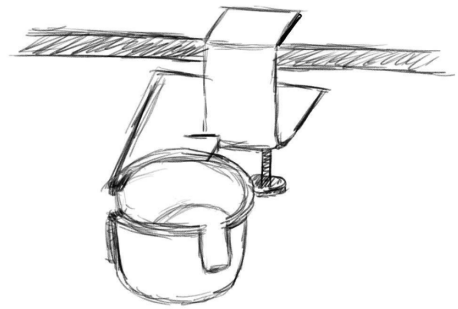
Concept 3.

Description:

The cup holder is designed to be placed next to the table. The cup holder has teeth and the upper part is tightened to fix the cups of different shapes. Adjustable screws to fit tables of different thicknesses, and it comes with rubber pads for anti-slip properties. Optional rotation to save space when not in use.

Design Specifications:

1. The material of the cup holder will use ABS plastic which provides good sturdiness and also more lightweight.
2. The height of the cup holder can be designed between 5-10 cm.
3. The diameter of the cup holder will be designed



How to assemble:

Put the screws through the bottom and determine the position of the device before tightening it. Then tighten the screws until the entire cup holder is fully secured to the table.

How to repair:

to be around 8 cm and the tightened top design will provide better stability.

4. Composed of three parts, so assembly will not take long.
5. 3D printing will be used in the design of the cup holder, the cost of the screw and the rubber pad will be in our target specification.
6. The time to complete the project will not be very long, it will depend on when the CAD model is completed, once the CAD model is determined by the client, the entire project can definitely be completed within two weeks.

How it is repaired will depend on the extent of the repair needed. If the repair does not affect the usability and firmness of the whole device, it will be easy to repair with glue or other materials. If the repair of the cup holder will affect the firmness of the cup holder, we will choose to re-3D print to obtain a new device.

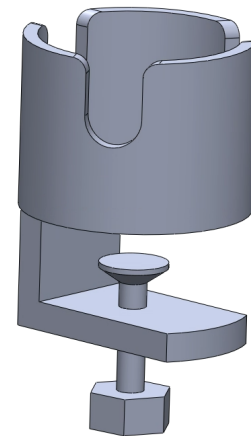
Concept 4.

Description:

A cup holder with an extension below to be slid onto a tray and clamped securely using a threaded bolt. There are 3 slots for cups with handles. The surfaces in contact with the tray will be rubber to add friction. The prototype could be 3D printed, and threaded inserts could be added to allow proper movement of the bolt.

Design Specifications:

1. The minimum opening to slide onto a tray can easily be designed to be above our target spec of 2.55 cm.
2. The cup holder height can easily be designed to be within our target specifications of 5-10 cm.
3. The cup holder diameter can easily be designed to fit the appropriate cup size from our target specifications.
4. The time to assemble the design should be within



How to Assemble:

The bolt must be threaded through the hole at the bottom of the device. Once the bolt is threaded through, the rubber head can be attached to the tip of the bolt which will be in contact with the tray. Once the device is fitted onto the tray, simply twist the bolt until the device is securely tightened to the tray.

How to Repair:

our target specifications of less than 15 seconds.

5. According to the CAD model, the mass of the design is 225 g, which is far less than our target specification.
6. The reliability of the design should be very good as it has very few parts and will have a strong construction.
7. The material of the design will be PLA or ABS plastic for the cup holder and metal for the bolt. This should make the product washable by hand.
8. The product has a high ease of use as it is very simple.
9. The total height of the design is around 14.5 cm when fully extended, which is below our target specification.
10. The total diameter of the design is around 8 cm which is far below our target specification.

In case of the cupholder breaking, the part must be 3D printed again. In case of the rubber tip being broken, a new rubber tip can simply be placed at the tip of the bolt. If the bolt breaks (which is highly unlikely), or if the threads of the thread insert breaks, simply remove the bolt and thread insert and replace the components.

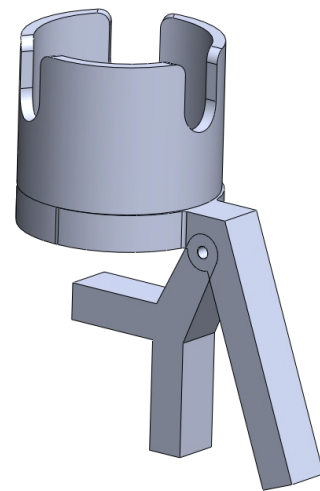
Concept 5.

Description:

A cup holder and clamp combined into an easy to use design. There are 3 slots for cups with handles. The clamp surfaces in contact with the tray will be covered in rubber to add friction. A spring between the outer and inner clamp arms will allow the user to easily clamp the cup holder onto the wheelchair tray and provide enough resistance to secure the cup holder on the tray.

Design Specifications:

1. The minimum opening for the clamp to be fit onto a tray can easily be designed to be above our target spec of 2.55 cm.



How to Assemble:

2. The cup holder height can easily be designed to be within our target specifications of 5-10 cm.
3. The cup holder diameter can easily be designed to fit the appropriate cup size from our target specifications.
4. The time to assemble the design should be nearly instant as it is quick and easy to install.
5. According to the CAD model, the mass of the design is 225 g, which is far less than our target specification.
6. The reliability of the design has the potential of being less than desirable if the spring mechanism is not manufactured correctly. The repairability however will be easy.
7. The material of the design will be PLA or ABS plastic for the cup holder and the clamp arms. A metal dowel and metal spring will be used for the clamping mechanism.
8. The product has a high ease of use as it is very simple.
9. The total height of the design is around 16 cm, but can easily be modified to fit our target specifications.
10. The total diameter/width of the design is around 13.6 cm which is above our target specification, but can easily be modified to reach our target specification.

The user must simply take the clamp part of the device and squeeze the two arms together to create the opening to clamp the cup holder onto the tray.

How to Repair:

If the two main parts are broken (inner clamp arm, and cup holder with outer clamp arm), the parts must be reprinted. If the spring is broken, a new identical spring can easily be fitted by slotting it into its location on both clamp arms. If the dowel pin is broken, a new dowel pin can simply slide into the hole.

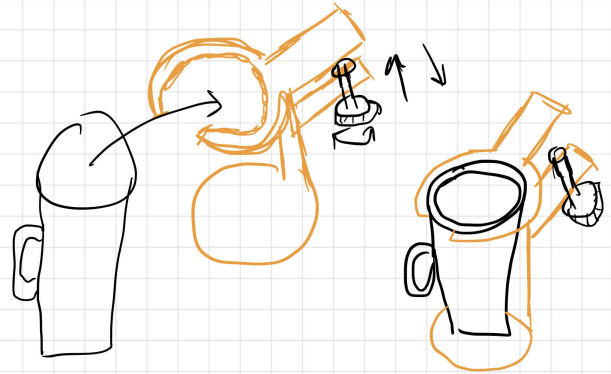
Concept 6.

Description:

This concept has the objective of completely eliminating the presence of the cup on the tray. This is achieved by clamping on the side of the tray, the cup holder. Furthermore, the cup will sit flush with the surface of the tray. To place the mug you simply slide it in from the top, if the diameter of the mug increases in size, it will simply go down until it is stopped by the top part (bracket). If the mug has a smaller diameter than the top part, it will simply sit on the bottom plate. For this concept to work at its best, it will need to be designed by taking into consideration Nicki's mug dimension to have a nice snug fit.

Design specifications:

1. The minimum opening of the clamp will be greater than 2.55 cm.
2. The cup holder height requested can easily be achieved.
3. The cup holder will be made out of anodized aluminum sheets by using a laser cutter. The parts can then be welded together to guarantee sturdiness and resistance to any type of hit or fall. Also, the aluminum will resist corrosion and the cup holder will be hand washable. The clamp bolt can be bought from a store.
4. The time to assemble should be less than 15 seconds, since the only thing to do is tighten the clamp.
5. The weight should be under 500g since



How to Assemble:

When the product is given to the user, the only thing to do is clamp it. This can be done by twisting the threaded bolt at the bottom.

How to Repair:

This device shouldn't break if used properly.

Unfortunately, if a weld breaks, it cannot be repaired at home, and must be re-welded.

<p>aluminum has a low density compared to steel.</p> <ol style="list-style-type: none">6. This design should be very reliable since the mug won't be above the tray, as a result it can't be hit by accident. Also, the system itself is made of metal, making it hard to fail.7. The cup holder and system height will be at around 10 cm, which is between our target specification8. The cup holder and system diameter will be at around 8 cm, which is between our target specification.	
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Justification of the Evaluation Process

The evaluation of the different concepts were made by analyzing the ideas and ensuring that they would meet the metrics that we have set. The ideas and concepts that were ideal for our set metrics were selected as the best options for further development. For the concepts chosen, we ensured that each prototype would be able to satisfy the target specifications. On top of needing to satisfy our target specifications, the concepts should realistically be viable for the user and take into account their needs. We therefore made sure that the chosen concepts would satisfy the clients needs such as the need for a rugged design, an easy and simple to use solution, or even the idea that the cup holder could be off of the tray to prevent the user from accidentally knocking into the drink. All other evaluations were based on the material, the design considerations, and the manufacturing considerations for each concept/prototype.

Chosen concepts

We chose concept 4 and a mix of the designs between concepts 3 and 6. To make the mix between concept 3 and 6, we created a new design.

Description of Concept 3 and 6

Concept 3 and 6 were combined to form a general concept. This can be seen in the sketch below. The design has a clamp to hold the project onto the table and then has a circular base and ring in order to hold the cup in place. The design on this system removes the cup from being on the table and instead has the cup being held just to the side of the table. This is being introduced as an option for the user to choose from as they voiced that they didn't want to make the wheel chair any wider than it currently is, which the cup may do. We don't have exact measurements of the widest point of the wheelchair, but once given, we will edit the measurements of this design to remain below the widest point.

This device has the capability to meet all target specifications. In order to do so, it must be ensured that the device will not not widen the wheel chair, as well as still fit the cup. The material of the design must also be determined. Since this is a prototype, manufacturing method, as well as material has not been specifically chosen. It would be preferable to have a lightweight but strong material that is preferably waterproof and has a high melting point. The prototype would be easy to install and store, and depending on the chosen manufacturing method, it would be easy to repair. The device would be difficult to 3D print, so a method of machining a piece of metal will most likely work best. Once exact measurements of the wheelchair have been given, the design specifications of this prototype will be completed. Exact testing and values will come from creating a physical prototype.

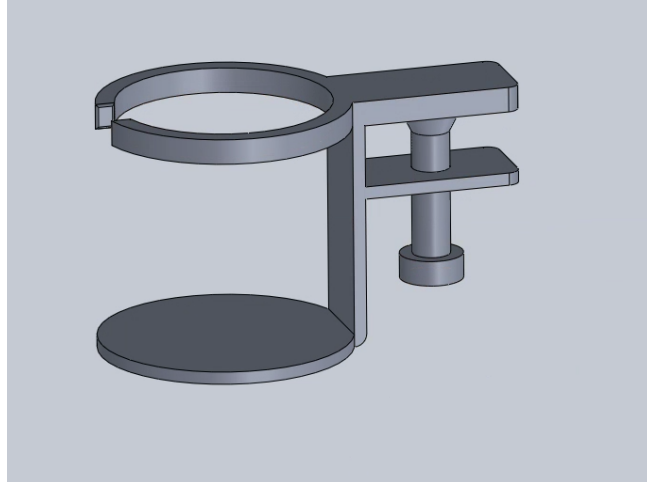


Figure 1. CAD Model of the Mix of Concept 3 and 6.

Benefits of Concept 3 and 6

- Creates more room on table
- No longer in area to come in contact with the users arm
- Small and simple design
- Has minimal parts
- Easy to install

Drawbacks of Concept 3 and 6

- Might make wheelchair wider
- Would be difficult to manufacture
- More stress would be placed on the attachment of the base and support

Description of Concept 4

Concept 4 of the cup holder was deemed to be one of the suitable options we wish to develop for the client. It is a simple solution, it requires few parts, it is easy to use, and easy to fabricate. As seen in table 1, it has the potential to meet all our target specifications. The dimensions of the cup holder itself will be able to fit most cups, but can be easily modified to match our clients cup size. The overall dimensions are within our target specifications and even

provide a smaller solution than expected, which is good for storage. The time to assemble should be well within our target specification, but will need to be tested through prototyping. Furthermore, the material used, the device's ease of use, its reliability, cost, and other specifications all seem to be met with this concept. The device's benefits and drawbacks are outlined below. This will further guide us towards building useful prototypes and implement improvements to mitigate the drawbacks.

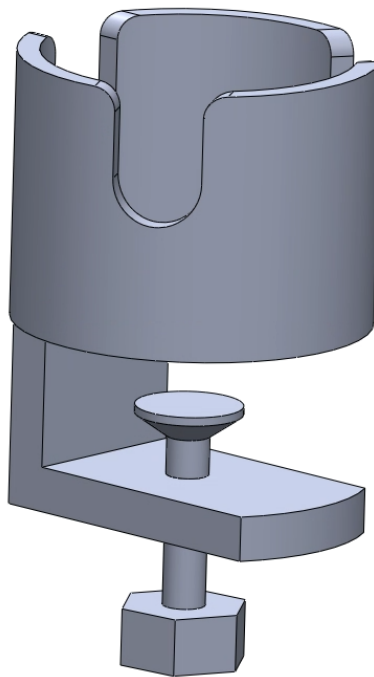


Figure 2. CAD Model of Concept 4.

Benefits of Concept 4:

- Few parts
- Easy to install
- Easy to manufacture (3D print)
- Can fit cups with handles
- Able to be placed at desired location on the tray
- Rugged design

Drawbacks of Concept 4:

- If large part breaks, fixing will most likely require re-printed the whole piece
- Can come in contact with users arm

Conclusion

When it comes to developing a product, creativity skills are just as important as critical thinking skills. This deliverable is where we put our creativity skills to the test to generate ideas for our product without fear of judgment. Creative thinking is essential for critical thinking because a concept can only be evaluated after it is generated. The more ideas, the more possibilities there are for a high quality product. The description of each concept in this deliverable is documented with detail in case we feel we might change our chosen concept in future deliverables. Initially, we came together as a group and displayed each of our ideas, we then chose 3 ideas that fit best with our preferred design. The CAD models of these ideas were updated and then analyzed. We end up with two CAD models based on 3 concepts that will be used for prototyping in the near future. The prototypes will mainly consist of a cup holder with a bolt mechanism used to clamp the device onto the tray, with one concept allowing the cup to be on the tray, while the other will consist of the cup being beside the tray.