GNG2101

Project Deliverable C

Submitted by

Group A2.5

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Abstract

Through the process of generating concepts via sketching and research, our group chose a final concept. This was done through group discussion, as well as analyzing the pros and cons of each concept with concerns to feasibility, functionality, production time, and cost. We were able to decide on a concept that is lightweight and cost efficient, avoids the usage of complicated mechanical systems and overall will be easy to use. This concept is called “SCC,” or Sunwoo’s Clamping Concept, where a ‘u’-shaped bar will be attached in the middle to the bike handle’s post, secured with a tighten screw, and the other end will have two prongs which will be attached to the wheelchair’s handles.

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Prototype _ C	Sunwoo's prototypes
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Prototype _ S	Sean's prototypes

1 Introduction

Our team was assigned the task to create a concept design of an inclusive bike to show our client during the next meeting. We each took time to research and developed 3 concepts each, a total 12 between the group. We had a meeting to narrow our decision down to 3 concepts. It was important to ensure we fulfilled our clients, such as the ability to travel at higher speeds, being able to maintain a clear view in front of them and also ensuring stability and safety. We also discussed our own skills needs and which concepts seemed the most feasible that we can create with the time given. Upon deciding on our 3 favourite concepts, we had another meeting to further discuss which of the 3 would allow us to achieve the most success. We finally decided on a design that will allow the clients to be seated in front of the bike and will keep them the most secure. The wheelchair will be attached by two pipes protruding out of the handles and held together by screws. It will also be foldable to allow for easy storage. We believe that this concept will not only fulfill all the needs of our clients, but also manageable for us to design, build and test. This report will demonstrate our design processes and explore our critical thinking as to how we made our final decision.

2 Functional Decomposition

Figure 1 below is a decomposition of our full functioning system into subsystems.

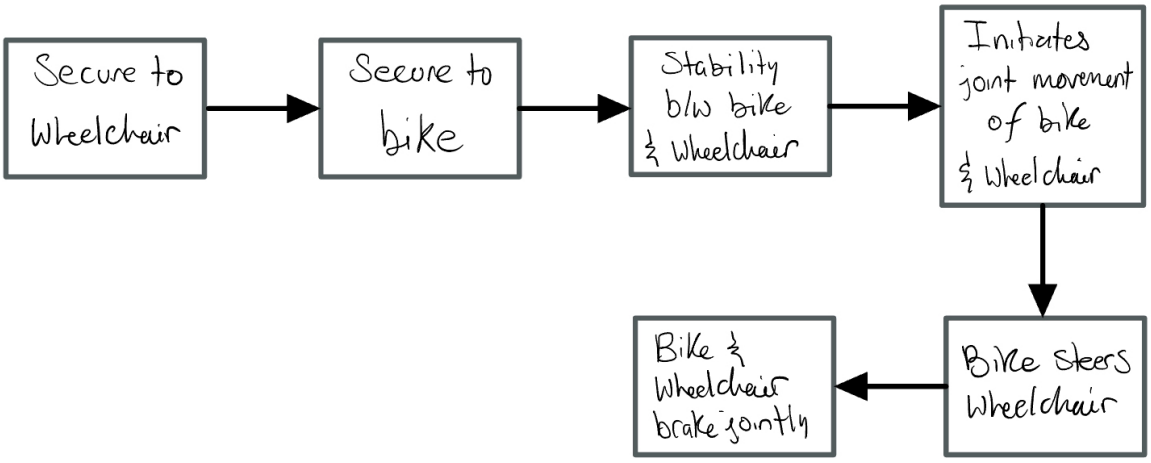

Figure 1 Functional Decomposition

3 Concept Generation

In this section, each team member has created three different concepts, either full systems or subfunctions, based on our client needs. Each prototype is then followed by a pros and cons list to better understand the design concept.

3.1 Adriana's Concepts

3.1.1 Concept 1

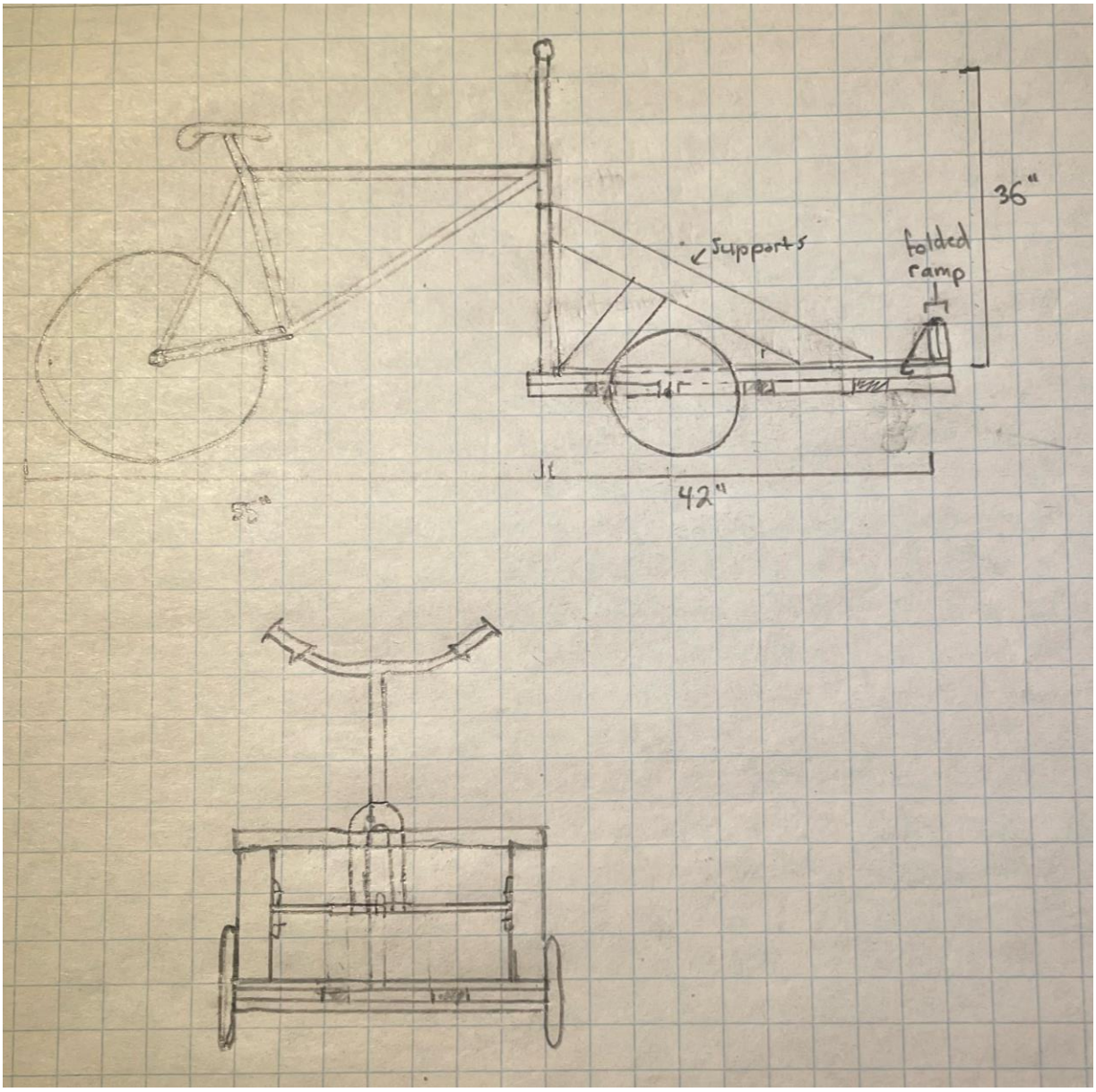

Figure 2 Front Platform Bike

Pros:

- No front wheel makes it easier to steer
- Fold out ramp is easy to use and out of the way
- Includes triangle supports for stability
- No excess pressure on the wheels from turning

Cons:

- No front braking from the removal of the front tire
- Not easily transportable
- Potential for falling over when loading due to weight distribution

3.1.2 Concept 2 – Subsystem

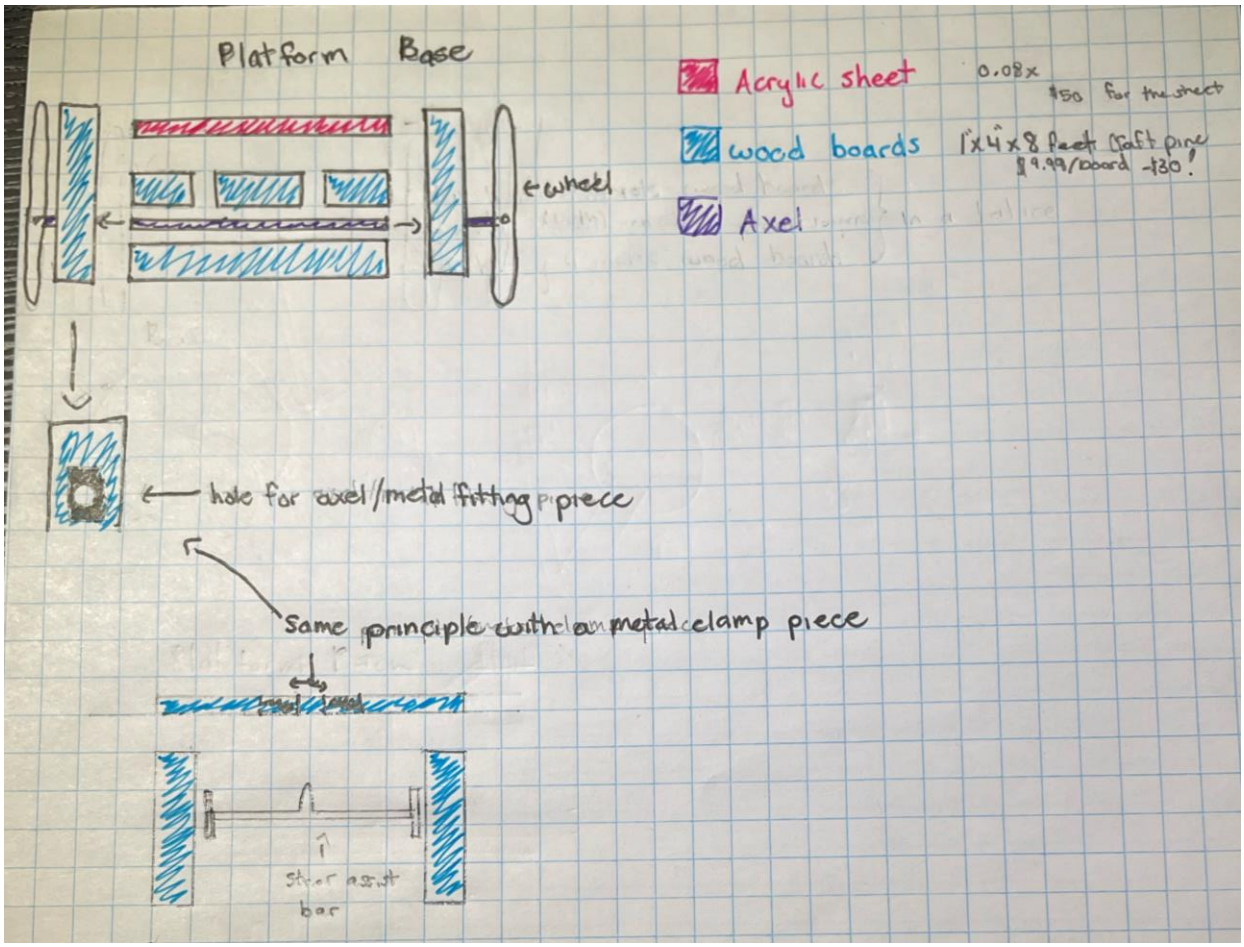

Figure 3 Platform Base

Pros:

- Includes plexi glass for a smooth surface to roll onto
- Incudes wood to strengthen the platform
- Supports alleviate pressure on the steering mechanisms

Cons:

- Expensive to produce
- Requires the removal of the front tire
- Heavy

3.1.3 Concept 3 – Subsystem

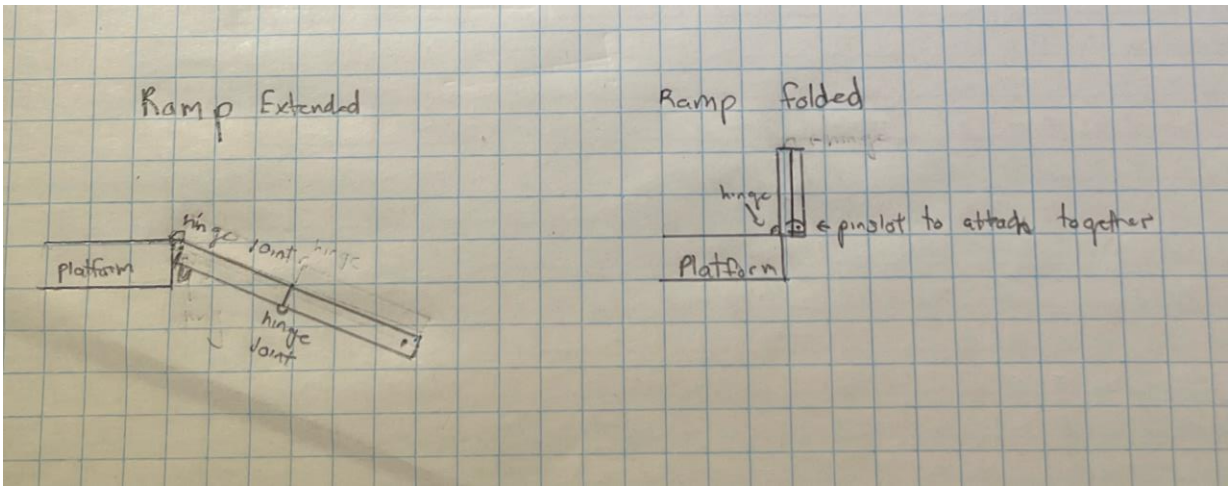

Figure 4 Ramp

Pros:

- Easy to fold
- Hinges are placed so that the ramp will not collapse when in use

Cons:

- Bulky, not aesthetic
- Potential for movement if not secured properly

3.2 Sean's Concepts

3.2.1 Concept 1

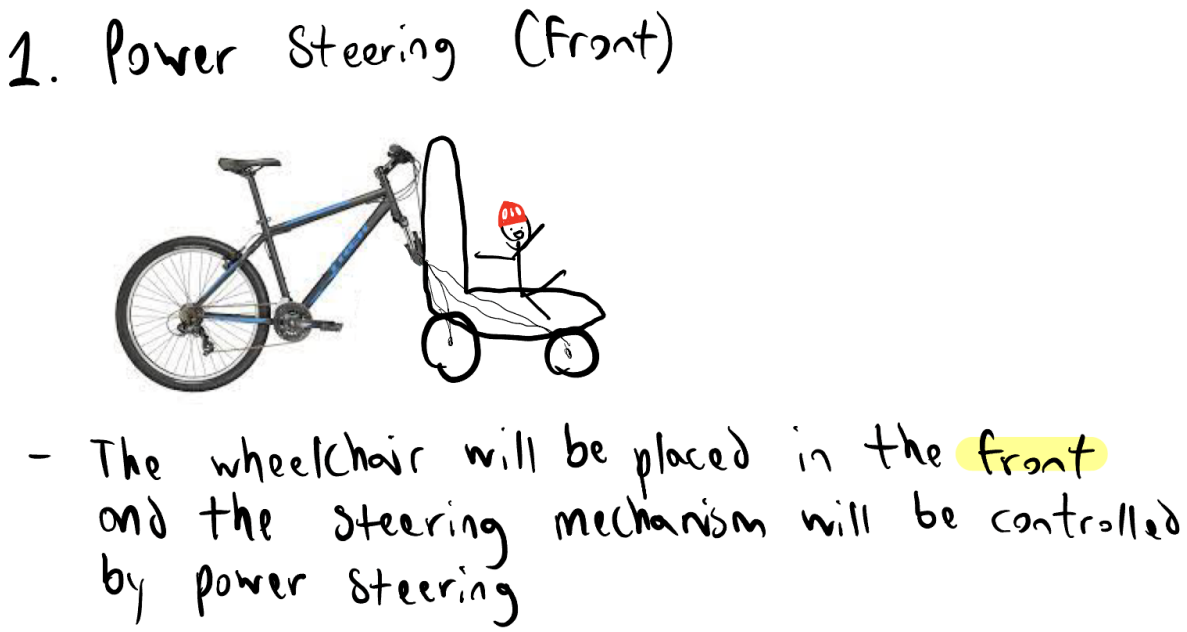

Figure 5 Power Steering (Front)

Pros:

- Controlled steering
- Easy to navigate
- Strong against wind
- Safer at high speeds
- Better view

Cons:

- Difficult to design
- Expensive
- Hard to steer

3.2.2 Concept 2

Figure 6 Wheelchair to the Side

Pros:

- Can see the passenger
- Can interact with passenger
- Good view
- Better Steering

Cons:

- Hard to balance
- Difficult to turn
- Bike would have to be heavier/ have a counterweight
- Too large or bike path
- Expensive to produce

3.2.3 Concept 3

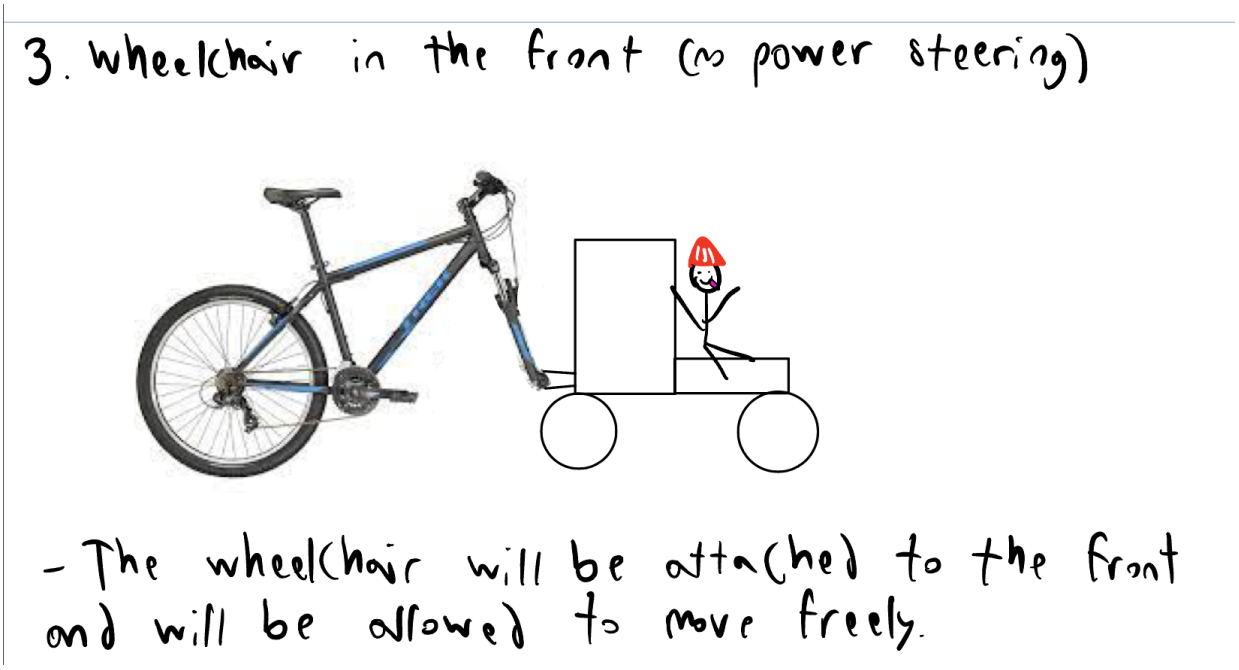

Figure 7 Wheelchair in the Front (no power steering)

Pros:

- Cheaper
- Lightweight
- Easy to design

Cons:

- Less stability
- Less power (more force needed)
- Can't interact with passenger

3.3 Anastasia's Concepts

3.3.1 Concept 1

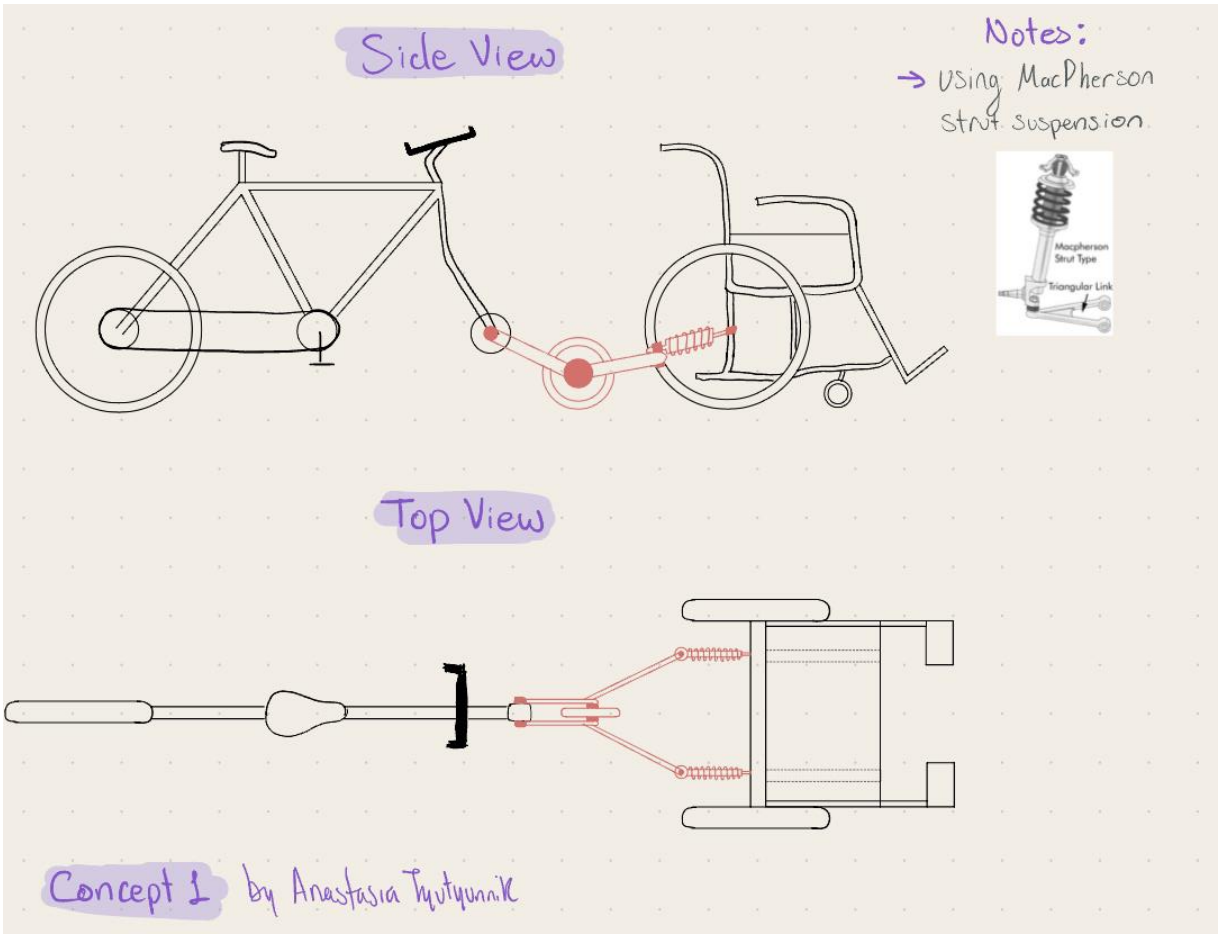

Figure 8 Suspension Attachment

Pros:

- MacPherson strut will absorb shock and reduce discomfort for user
- Middle wheel adds additional support
- Joint attachment with strut and leading arm allows for independent movement of the bike wheel vs. wheelchair

Cons:

- Possible BM at bike wheel hub
- Requires removal of front wheel
- Steering would be affected negatively

3.3.2 Concept 2

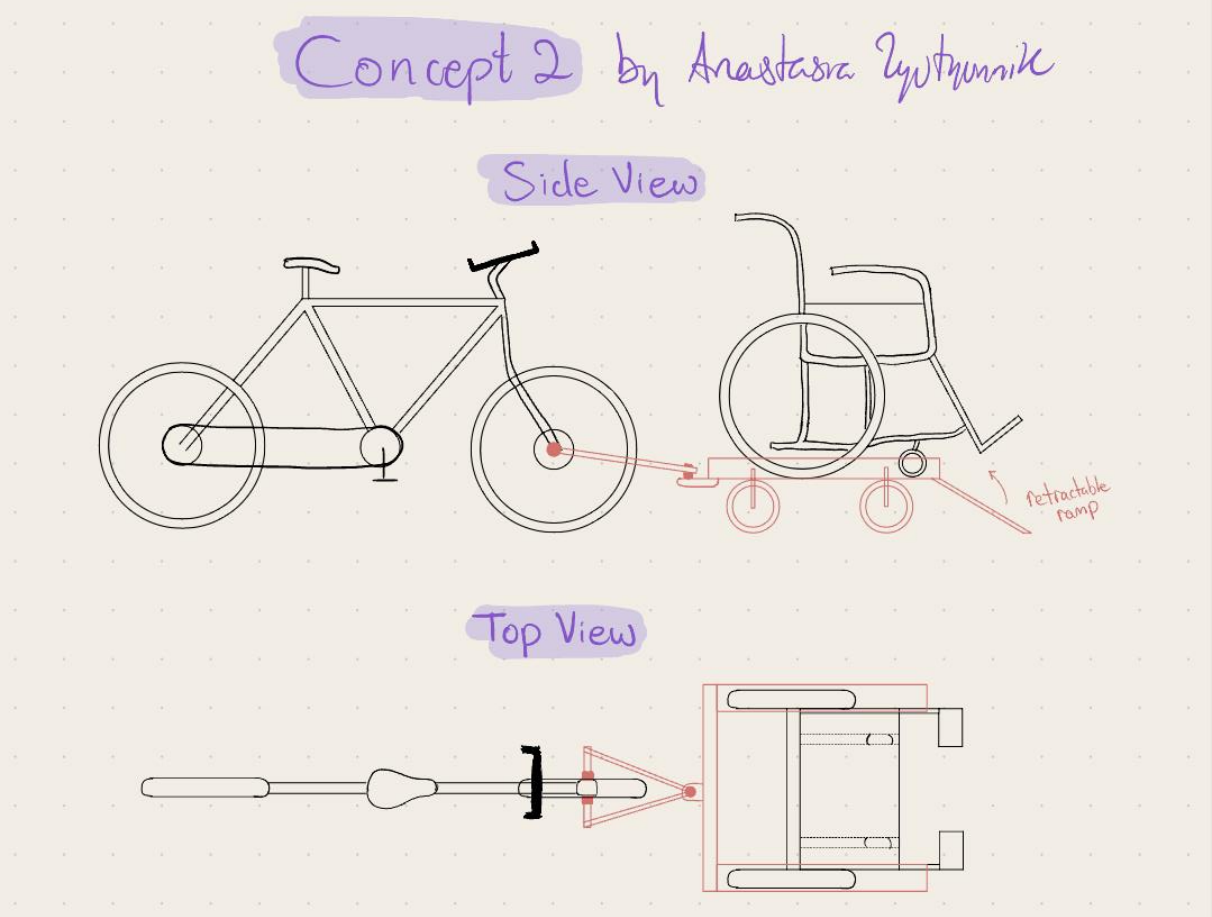

Figure 9 Platform Front Trailer

Pros:

- Does not rely on the wheelchair wheels
- Can secure the wheelchair well and easily
- Easy to get on and off
- No modifications to bike or wheelchair

Cons:

- Steering will be difficult
- Expensive to produce due to large amount of material used
- Does not secure front small wheels

3.3.3 Concept 3

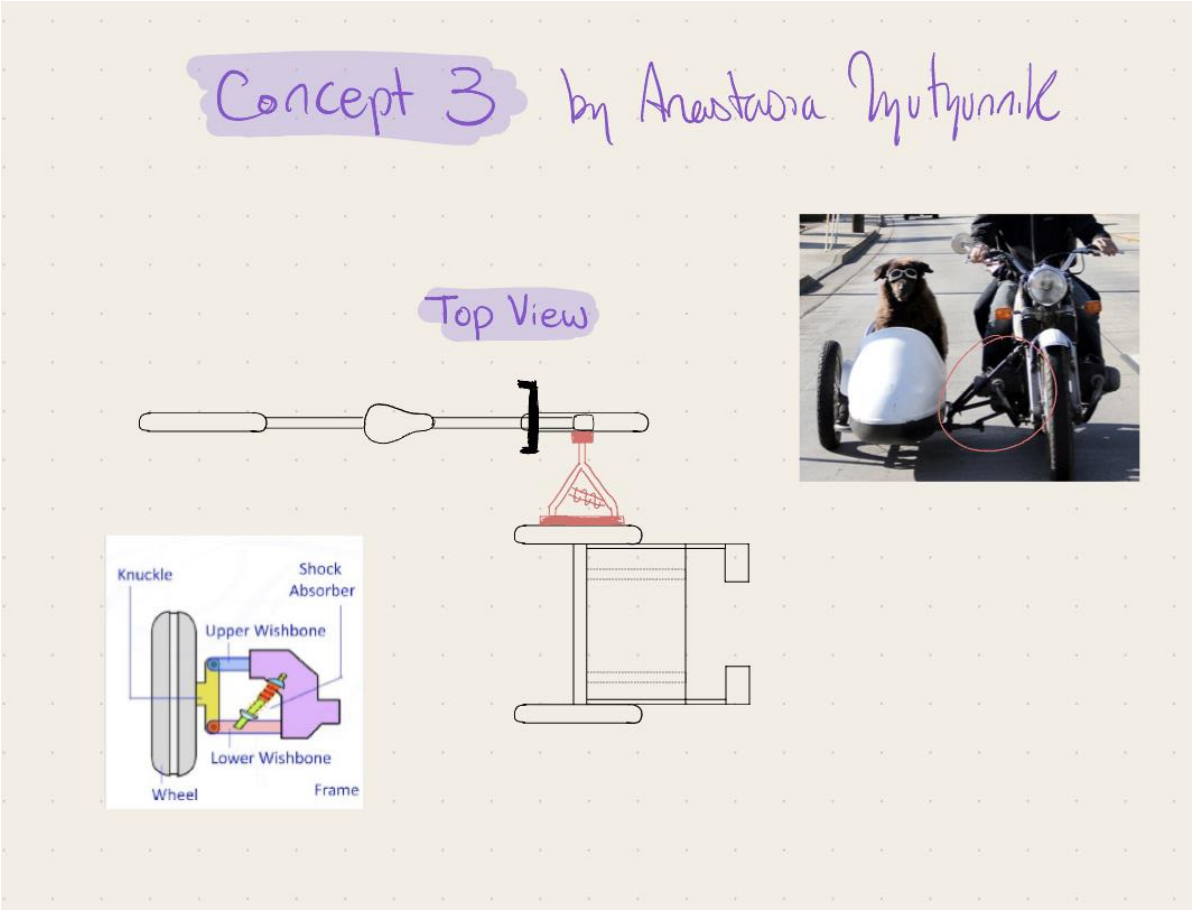

Figure 10 Side Wheel Attachment

Pros:

- Easier to steer than previous two concepts
- Force transfer will be distributed better since it is more of a pull than a push movement while riding forward
- Already great existing concepts to build upon

Cons:

- Not in front of the bicycle
- May be too wide for a bike lane
- Steering may be difficult

3.4 Sunwoo's Concepts

3.4.1 Concept 1

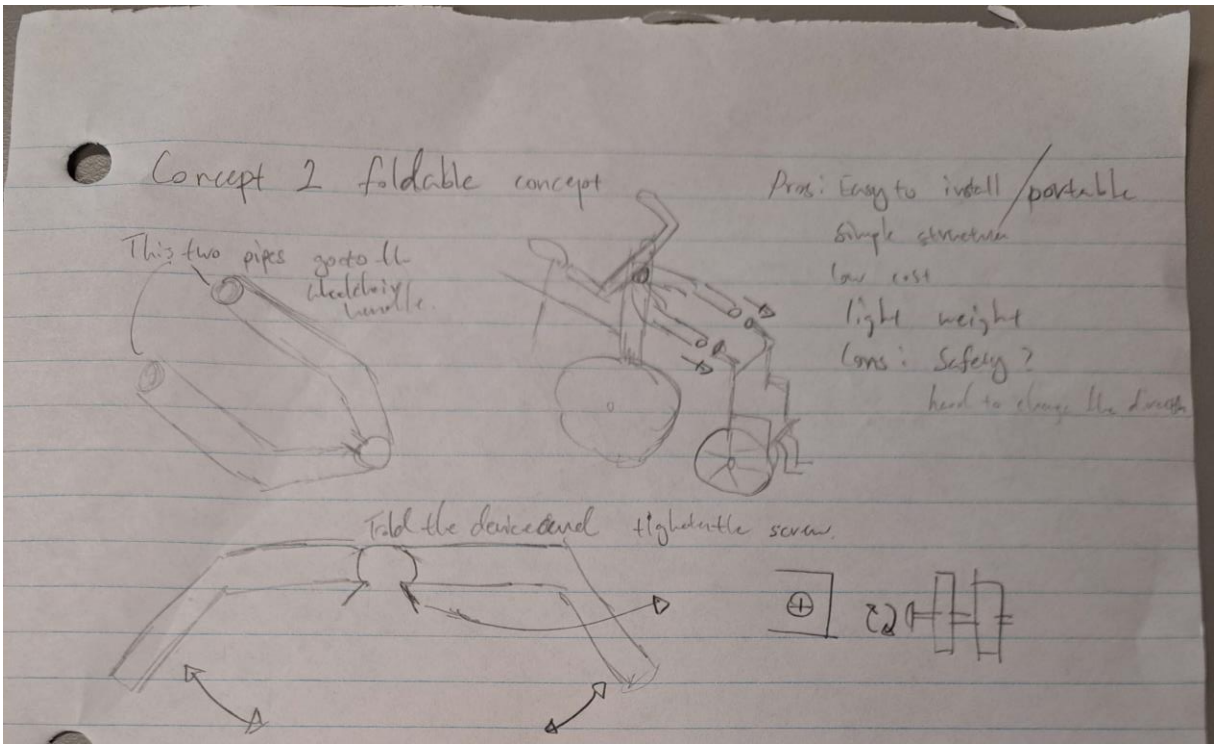

Figure 11 Foldable Concept

Pros:

- Easy to install
- Lightweight
- Low cost
- Portable

Cons:

- Safety concerns

- Unsure how it will clamp

3.4.2 Concept 2

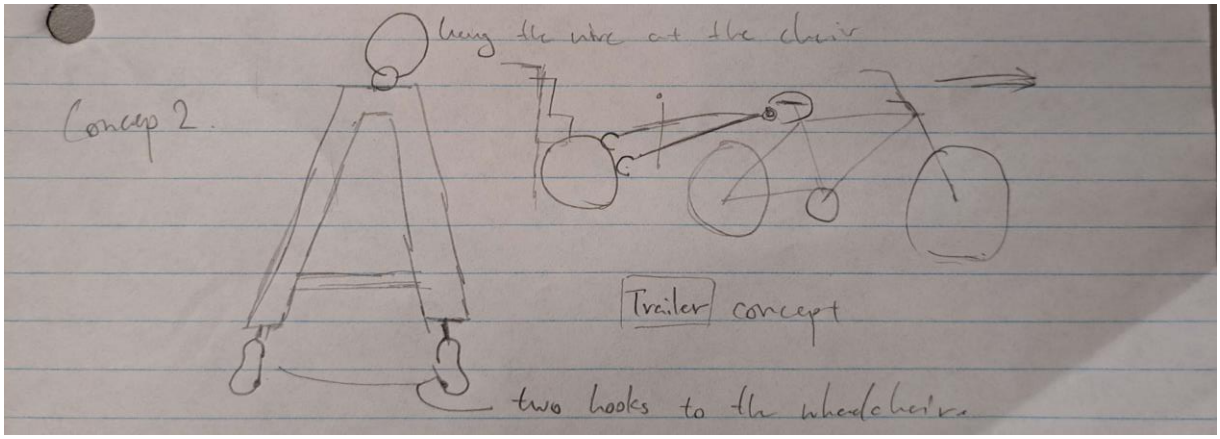

Figure 12

Pros:

- Easy to install
- Low cost
- Lightweight
- Easier to pull with a bike than it is to push

Cons:

- In the back, clients want to be at the front

3.4.3 Concept 3

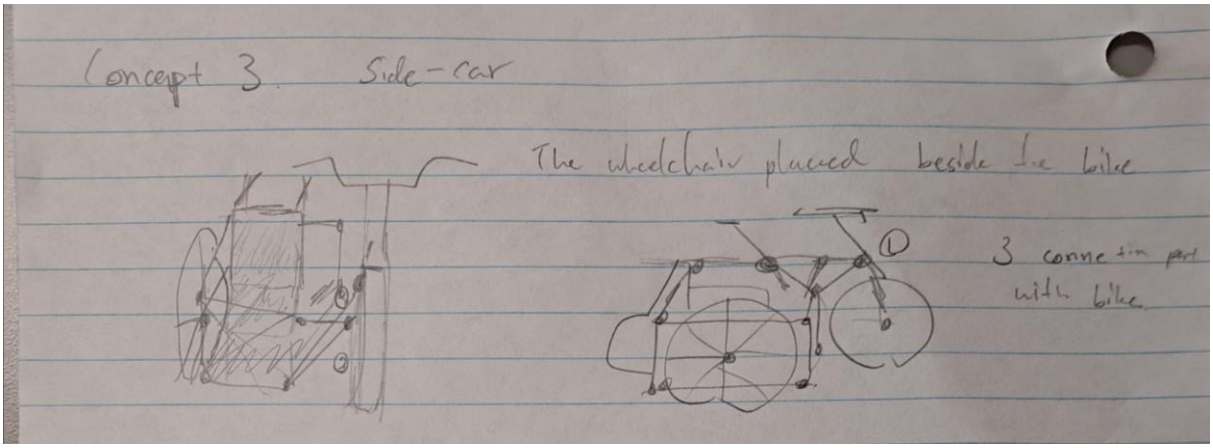

Figure 13 Sidecar

Pros:

- Does not use the tires of the wheelchair

Cons:

- Heavy
- Expensive
- Complex structure
- Can only see on one side
- Too big for bike paths

4 Concept Selection

To select our group concept, our team has created a decision matrix (Table 1) based on our target specifications. From this matrix, our team was able to rank and compare each prototype, which then lead to us taking the three best designs to further analyze and choose the best option. We also wrote notes on our opinions of each concept which has been provided below as well.

Selection Criteria	Prototype 1 A	Prototype 1 C	Prototype 2 A	Prototype 3 A	Prototype 1 S	Prototype 2 S	Prototype 3 S	Prototype 1 D	Prototype 2 C	Prototype 3 C
Ease of fabrication	0	plus	minus	0	plus	plus	minus	minus	plus	minus
Easy to steer	0	plus	minus	plus	0	plus	0	plus	plus	plus
Portability	0	plus	minus	0	plus	plus	minus	minus	0	minus
Likelyhood of Success	0	plus	0	plus	plus	plus	minus	plus	plus	plus
Cost	0	plus	minus	0	plus	plus	minus	minus	0	minus
Location of User	0	0	0	minus	0	minus	0	0	minus	minus
Ease of Breaking	0	plus	plus	plus	0	plus	0	0	plus	plus
Overall Score	0	6	-3	2	4	6	-4	-1	3	-1

Table 1 Decision Matrix

Person	Concept 1	Concept 2	Concept 3
Sean	• Power steering would not work connect into their preexisting wheelchair • Would be too difficult to take off the front tires • Braking issues due to the lack of front tire	• The levitating side piece would not distribute weight evenly	• Power steering would not work connect into their preexisting wheelchair • Would be too difficult to take off the front tires • Braking issues due to the lack of front tire
Anastasia	• The steering would not work but it works better than the other concept due to the struts • The connection going through the wheel helps with steering	• The axis of rotation would not transmit steering well • Cannot push a connection	• Steering may be heavy • May block off the view • Better steering
Adriana	• Most feasible idea in terms of steering and holding the passenger	N/A Subsystem assessed as part of concept A	N/A Subsystem assessed as part of concept A

	• Need to add hinges • Axis of rotation is off with one tire • Complex to create and expensive • Most intricately thought out • Breaking issues due to lack of front tire		
Sunwoo	• Very secure with the screws • Cost effective • Lightweight • Infront of the bike	• Easy to steer • Not where the client wants to be in terms of wheelchair placement	• Easy to design • Good view for client • Use of platform means there is less use of wheelchair tires

Table 2 Notes from Group Meeting

5 Combined Design Concept

The standard for determining the group's representative concept was whether it satisfied the conditions given to us. First of all, we have to meet the customer's requirements well, and we should make it with the time and budget given to us. There were many creative concepts, but we chose the clamp concept as our group design because we lacked time or needed too much money. This design is represented in figure 14 below.

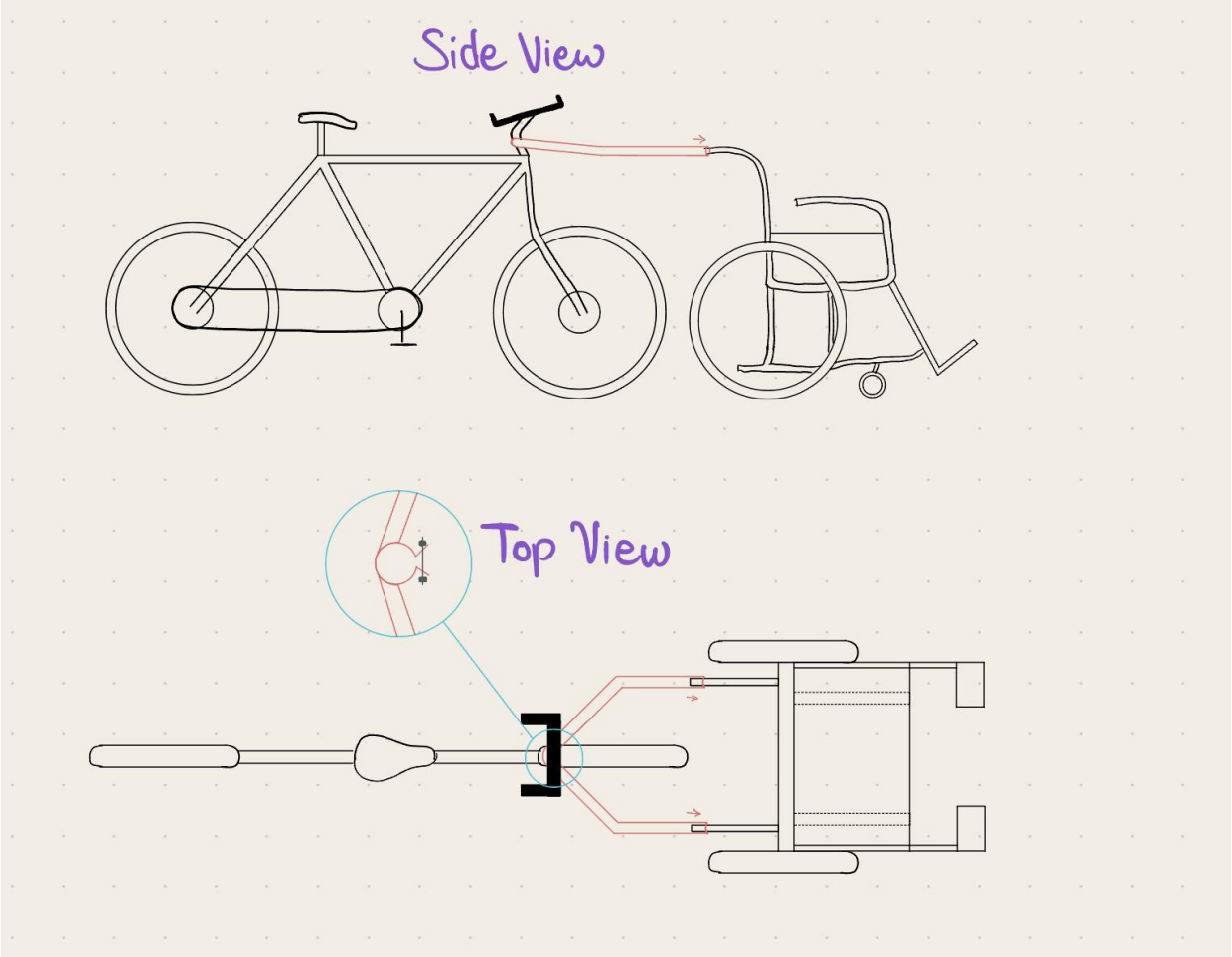

Figure 14 Group Concept

This concept was created to reflect customer needs as much as possible. It is quickly installable and safe, and it is made with a focus on sitting in front of a bicycle. Reiterated in table 2 below is the target specifications in which our design is based on.

Metric	Value	Unit
Size	100-110 X 55-65 X 85-95	cm
Cost	300-500	CAd
Weight	15-20	LBS
Lifespan	30+	Years

Speed	0-30	Km/h
Material	Aluminum frame, rubber tires	N/A
Maximum Force	1300	N

Table 3 Target Specifications

The way to attach this product to a bicycle and wheelchair is very simple. Connect the clamp in the middle to the front of the bicycle and tighten the screws. Then, connect the two pipes that are out front to the wheelchair handle as they are, and you are done. Since folding is possible, the size meets the criteria previously set. Also, it is lightweight and cheap because it does not contain many parts and does not use any electronic equipment. There are no parts that need to be replaced periodically, so the life of the product is semi-permanent as long as it is well managed. The speed or transmission force will be tested later, and the material is likely to be light and hard stainless steel.

Pros:

- Easy to make
- Inexpensive
- Wheelchair located at front
- Lightweight
- Easy/quick install
- Portable

Cons:

- Unsure about steering
- No safety function/system

6 Conclusions and Recommendations for Future Work

In this report, we have clarified our core and sub-functionalities in a functional

decomposition diagram. While reviewing this diagram, we devised three prototypes per Conclusions and Recommendations for Future

teammate to start conceptualizing for our physical prototype. We then took our twelve prototypes and created a decision matrix based on the target specifications to come to an agreement on a single combined prototype design. During this deliverable, our team had issues with uploading documents to a shared google drive. It is recommended that next deliverable we write our deliverable in google for one person to format on word.

7 Bibliography

Davies, A. (2014, December 5). *Finally, a documentary about dogs riding in sidecars*. Wired. Retrieved October 2, 2022, from https://www.wired.com/2014/12/dogs-motorcycle-sidecars/

YouTube. (2021, February 3). *Macpherson strut, double wishbone, trailing arm suspension system types working animation*. YouTube. Retrieved October 2, 2022, from https://www.youtube.com/watch?v=oZz7RD7KRI0

YouWheel.com. (2015, January 27). *Automobile suspension design 101 (part IV): Macpherson strut suspension*. Medium. Retrieved October 2, 2022, from https://medium.com/@you_wheel/automobile-suspension-design-101-part-iv-macpherson-strut-suspension-753a4e2cd312

APPENDICES

No further information to be enclosed in this document.