

GNG 2102 - A03

Inclusive Bike - Group 3

Deliverable C

University of Ottawa

Professor: Rubina Lakhani

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Josh Larocque 300239349

Numan Ozturk 300272549

Kobe Belanger 300236085

Zhisheng Peng 300194928

Haonan Lin 300204423

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Introduction

In the past weeks, our team has developed a team contract, met with our clients to assess their needs, established a write schedule, and created a problem description. This deliverable will go over the restrictions of our design, the requirements (both functional and non-functional) of the final product, and how the client's needs will shape our design. After we have our design, we will meet with the client and explain our current design choice. We will gather their input and suggestions and consider them for our design. We will review the initially assessed needs with them and explain how each of these needs is met or exceeded with our design. Outline if any of their requirements could not be feasibly met and explain why. Furthermore, we will also ask questions about our design to them and listen to the feedback we receive. After assessing all the feedback on our design, we will determine the feasibility of each piece of input and best optimize our design accordingly.

C.1 Conceptual Design.

Product Functions

The functional decomposition is essentially a breakdown of a complex process into its subsystems. It can be beneficial to lay out all the different systems and functionalities of a design to individually assess their importance and determine how they will be implemented. For our project, the operation of the product may seem relatively straightforward. Still, there are, in fact, many different systems within the design that need to work independently of each other, and all contribute to fulfilling the problem statement and the client's needs. Every subsystem holds an essential part in the final design. Still, not everyone included in the decomposition will make it to the final concept if it is deemed unnecessary.

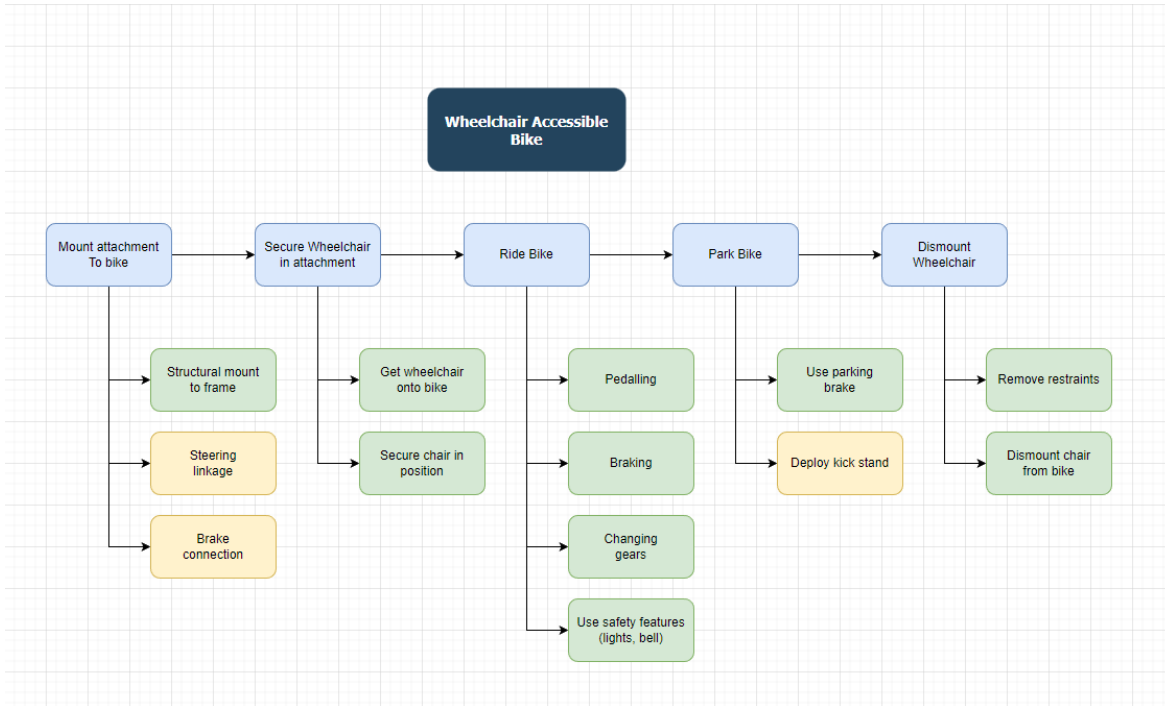


Figure 1.1: Functional decomposition of the wheelchair-accessible bike.

Current Product Design Concepts:

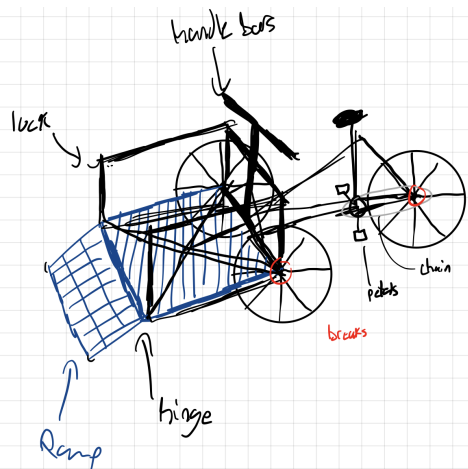


Figure 2.1.1: Josh's product concept bike with wheelchair platform and ramp

This concept attaches a platform to hold a wheelchair to a bike, and there is a ramp from the wheelchair to go up on the platform. The cons with this design are the weight distribution and the product's weight, as solid metal is needed. This design will also cost a lot as a lot of material is required in order to build it. This design would also not be

callable as we can not make the solid metal frame fold in half. Some pros are it keeps the client in front and allows for quick loading and unloading.

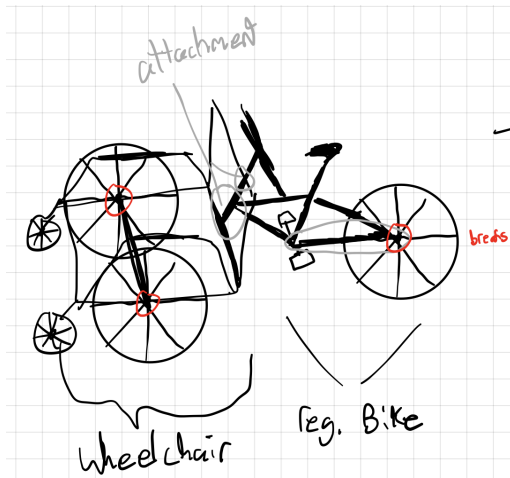


Figure 2.1.2: Josh's product concept bike that attaches to a mechanical wheelchair ***

This was one of my best designs because it met all design target specifications. It will attach a regular bike with the front wheel taking off to a mechanical wheelchair along the backrest. This design will be quick and robust and not affect the turning radius too much. This design can still be collapsible as long as the wheelchair can fold.

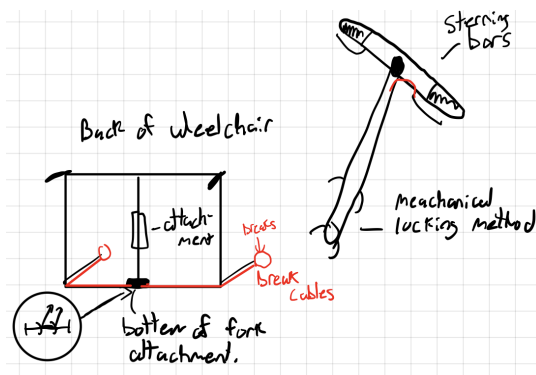


Figure 2.1.3: Josh's detailed mechanical attachment concept

This detailed image of figure 2.1.2 shows how we will attach the two. This design also allows for front breaks on both wheels of the wheelchair. We will use a locking pin, and u joint bolts to hold the bike's fork to the back of the wheelchair.

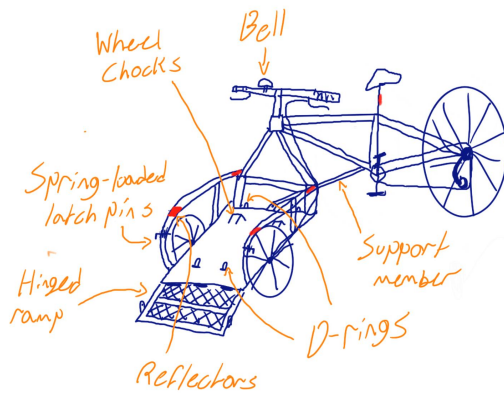


Figure 2.2.1: Kobe's custom bike concept drawing. ***

This design is essentially a bike with the front fork/wheel assembly replaced by a platform that a wheelchair would roll onto and be secured in place with wheel chocks.

Pros :

- The wheelchair is in front of the driver
- Sturdier than an attachment
- Very safe

Cons :

- It might be hard to steer
- Could be heavy
- Not collapsible
- Not an attachment (frame modifications required)

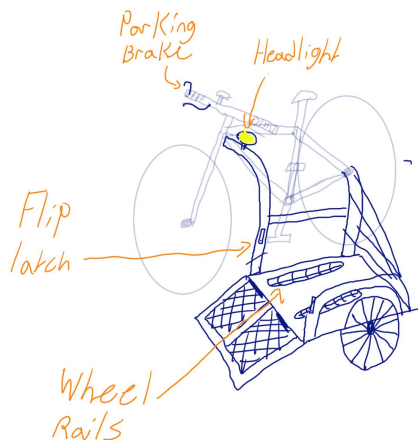


Figure 2.2.2: Kobe's "sidecar" bike attachment concept drawing.

This design also uses a platform that the wheelchair is rolled onto, but in this one, the wheelchair's wheels roll into rails that secure them, and the whole thing is an attachment to a normal bike and is mounted beside the driver.

Pros :

- Attaches to normal bikes
- Rails to lock the wheelchair in safely, quickly and easily
- Unobstructed front view of the wheelchair user

Cons :

- Increases bike's width considerably
- Could interfere with the driver's range of motion
- Not collapsible, but can be detached from bike in storage

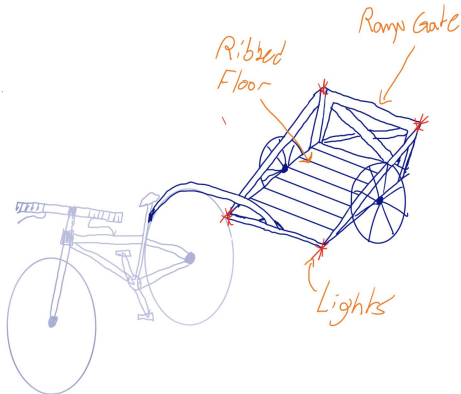


Figure 2.2.3: Kobe's trailer attachment concept drawing.

This design is a trailer that would be pulled behind the bike, and the wheelchair would again roll onto a ribbed floor to prevent them from rolling on the platform while the bike is in motion.

Pros :

- Simple to attach
- It wouldn't affect the steering
- Simple design

Cons :

- The Wheelchair user is behind the driver
- It could take longer to mount/dismount the wheelchair from the platform
- Not collapsible

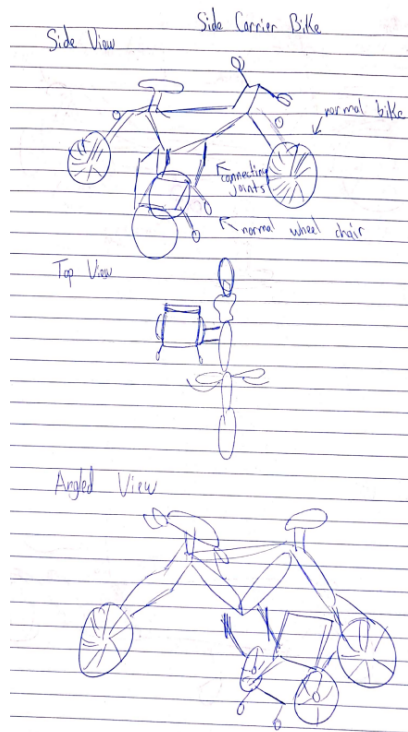


Figure 2.3.1: Nio's side chair concept

In this design, the wheelchair is directly connected to the main body of the bike by a connection mechanism that our group would produce. We assume that the bike and wheelchair are provided in this conceptual design.

Pros:

- Simple connection

Cons:

- Wheelchair not in front
- Both bike and wheelchair together are potentially expensive (surpass our spending limit)

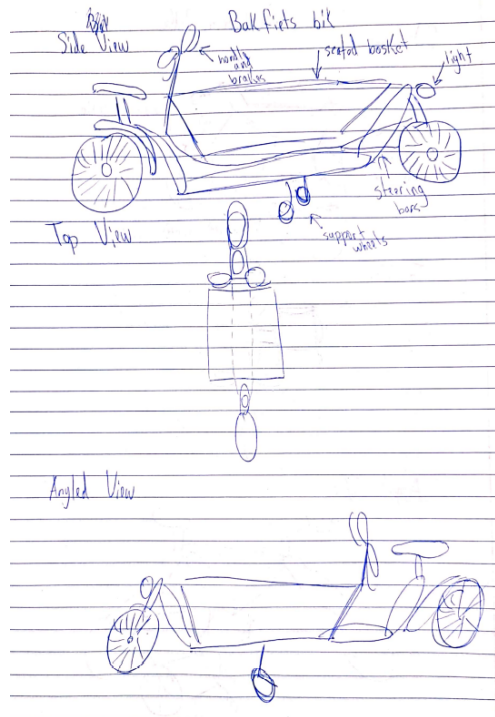


Figure 2.3.2: Nio's two main 2 assist basket wheel concept

This conceptual design is far more complex in the manufacturing phase than the other two I came up with. In this one, there are two large wheels and two smaller wheels and one main seating area in the middle that is not a wheelchair but can be considered a basket.

Pros:

- Far more steering control
- Can carry more weight evenly

Cons:

- Difficult to manufacture in a school environment with the limited resources provided to us
- Seating the client would be far more difficult.

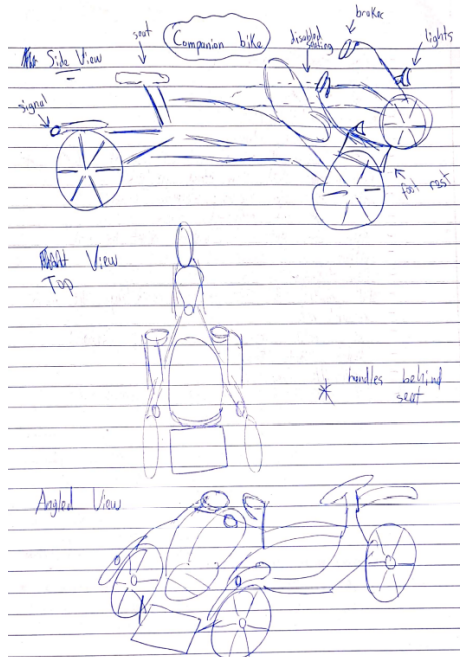


Figure 2.3.3: Nio's 3-wheel seated concept ***

The more superior design compared to the other two is the three-wheeler. In this model, we would cut/remove the front wheel of a basic road bike, connect a wheelchair to that available space, and include a steering bar to the front wheels of the wheelchair for assisted steering.

Pros:

- Loading clients would be effortless
- Minimal modifications would need to be made to accomplish the task
- Most plausible design

Cons:

- Potentially expensive since a bike and a wheelchair would need to be provided
- Steering might be a difficulty depending on the connective contraption.

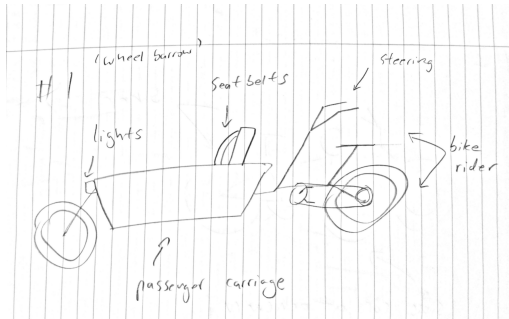


Figure 2.4.1: Eric's Wheelbarrow design

This design will have the wheelchair user sitting in a wheelbarrow seat in front of the steering. The pros are that it allows for the rider to be in front, is durable, and allows for reasonable control. The cons are that it is not an attachment and does not allow the user to use their wheelchair.

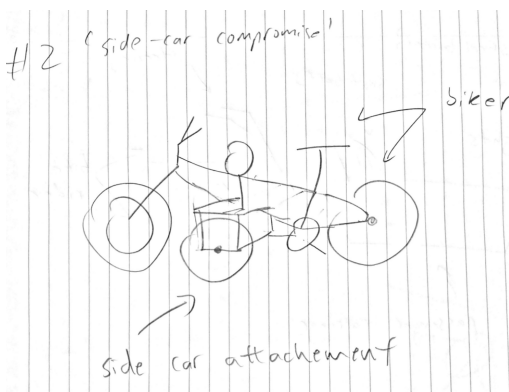


Figure 2.4.2: Eric's Side-car compromise design

This design works by having the user sit in a sidecar which can be attached to the bike. The pros are that it is an attachment and can be a compromise allowing for a more straightforward design and location for wheelchair users. The disadvantage is that the wheelchair user may not be able to use their own wheelchair, and the location is not entirely what the client wanted.

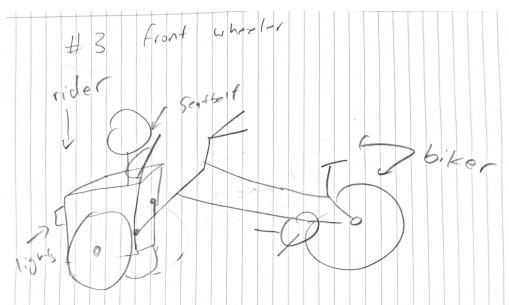


Figure 2.4.3: Eric's front wheeler design ***

This design works by removing the front wheel and attaching the wheelchair using an attachment. The pros are that it is in front of the bike and allows the rider full control. The con is that this design will not be collapsible.

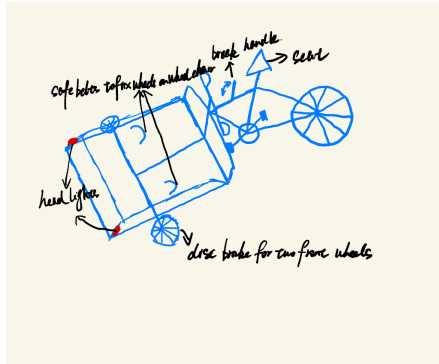


Figure 2.5.1: Haonan's bike concept drawing ***

The bike uses a front platform, which allows the wheelchair to be placed directly on the vehicle, and the bottom uses safety belts to fix the wheels.

Pro: The user does not need to leave the wheelchair, and the user experience is better

Con: The front end is too heavy for steering

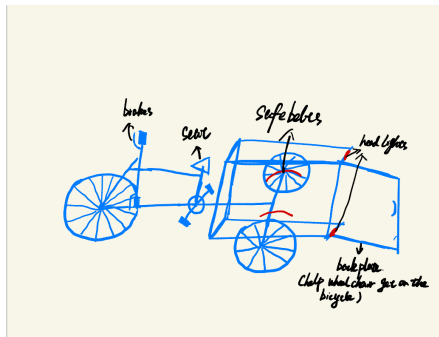


Figure 2.5.2: Haonan's bike concept drawing

The bike has a rear-mounted platform and added assisted boarding and alighting devices.

Pro: Easier for users to get on and off

Con: Does not allow the driver to observe the status of the user and does not facilitate the care of the user

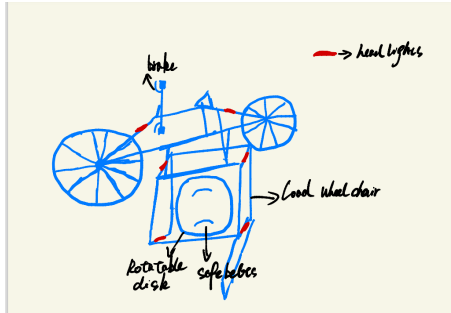


Figure 2.5.3: Haonan's side chair concept

The bike has a side-mounted platform and a rotatable disc on the platform

Pro: Easy to adjust the position of the wheelchair on the platform

Con: The left side is too heavy and afraid of tilting when moving

Evaluating our Initial Design Concepts

Our design will be a regular bike attached to a mechanical wheelchair. See Figure 2.2.1 for an example. It is the most feasible, least material, and meets most of our client's needs. We performed some basic physics tests on the different design concepts and found this one to work the best in weight and turning wise.

Best Solutions Developed

Our group has chosen these three to be the best designs based on the testing.

Figure 2.2.1: Kobe's custom bike concept drawing.

Figure 2.1.2: Josh's product concept bike that attaches to a mechanical wheelchair

Figure 2.3.3: Nio's 3-wheel seated concept

Visually Represent of the Chosen Concept.

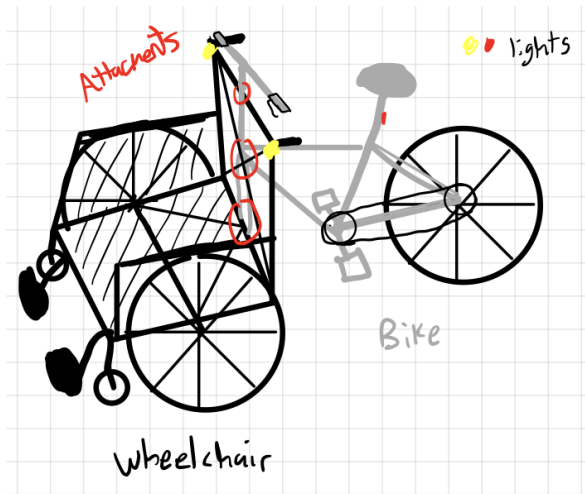


Figure 3.1: Chosen design concept

In this image, a regular bike without the front wheel will attach to a mechanical wheelchair and have strong connections with the ability to turn the wheelchair to guide the bike down the path. It is lightweight and easy to produce and attach.

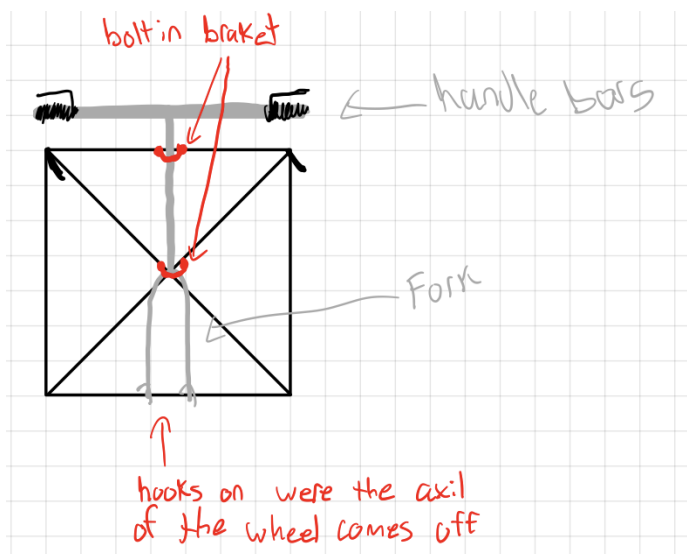


Figure 3.2: Chosen design concept

This is the helper's view of the use of the bike handlebar will turn and slow down. There are three attachment points along the back of the wheelchair, which will be strong enough to support the bike.

Our next steps are to start development and further testing on our product, and we want to get a hold of a bike and wheelchair so we can develop a method to attach the two together.

Relationship to the Target Specifications

The main target specifications related to our design are being an attachment to a standard bicycle, not requiring effort from wheelchair users to ride, allowing the wheelchair user to be in front, and allowing the bicycle rider to have complete control of the bicycle. These are our project's most crucial target specifications, and our design fulfills them all.

The main benefits of this design are being able to be attached to any bicycle after its front wheel is removed. It also allows the wheelchair user to be in front, allowing maximum enjoyment and comfort during the ride. As it is an attachment only, so it would mean any wheelchair and bicycle.

The main drawback of this design is the sacrifice of collapsibility. The attachment will not be collapsible, as we need to maintain structural stability during the usage of the machine. Some turning radii will be reduced because of the load on the front of the bike.

C.2 Project Plan

Wrike Snapshot link:

<https://www.wrike.com/frontend/ganttchart/index.html?snapshotId=CizLK8NErwyfJrMDIAI7hEvwISpB0A3%7CIE2DSNZVHA2DELSTGIYA>

C.3 Client meeting preparation

Client meeting plans

- Explain project plan
 - Where we are
 - What we have done so far
 - Where we want to go
 - Explain end goal
- Show them our design, ask for feedback
- Ask questions during the client meeting
- Ask permission to view a non-mechanical wheelchair and permission to take measurements

List of Questions for the Next Client Meeting:

- Are you comfortable with the safety features we have included? Would you want to add any extra features to make you feel safer?
- Which design is better attached to a regular bike or make our own bike?
- Which design is best for you
 - Attachment to a regular bike
 - Making our own bike to fit a wheelchair
 - Side by side bike
- How can we attach the wheelchair to the platform in the bike
- How easy and quick should the attachment be?
- Where will it be stored?
- Is stopping power an important metric
 - Does there need to be front brakes?
- The angle of the ramp onto the platform of the bike
 - How steep can it be before facing problems
- Ask to take pictures of their wheelchair (to see where we can mount a bike to it)
 - Bring a tape measuring to get accurate measurements
 - Ask which model
- Ask for contact information to ask further questions once they arise.

Conclusion

This deliverable involved all our group members contributing to the design process, where everyone produced three design concepts. A group meeting was held where we collectively analyzed our ideas and picked out the design aspects we liked the most. With our list of design elements, we came up with a final concept that met all the client's needs and our own. Upon creating our collective vision, we refined it and iterated this until we had a detailed version of the product that we found to be the best solution and will be shown to the client so we know what they think of it. At the meeting with the client, we will ask all the questions that need clarification and show them the concept we created. We hope to receive feedback from them regarding the design, which we will incorporate into our next version of the design before we start manufacturing a prototype. To conclude, the purpose of this deliverable was to use each of our conceptual design thoughts and combine them into a final concept that we believe will cover all the client's needs. To ensure this, we also used this deliverable to plan the next meeting with the client, where we will ask all of our unanswered questions and show them the concept we made to get their feedback.