Project Proposal

Bicycle for 16 year old (CP)
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Team #12
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Client:
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Summary

In this proposal we will discuss the background on our client, the purpose of our project, a few of our preliminary ideas, some previous designs and our expected budget. The purpose of this project is to provide a tandem bicycle for 16 year old Abby Miller. Abby was diagnosed with Cerebral Palsy as a child. She has limited control over her body. Ever since she was little Abby has wanted a bicycle but because of her medical condition she isn’t able to ride a regular bicycle. She used to have a pull-behind that her father built her but she grew out of it. Abby needs complete body support including support of her head, her neck, and her torso. Our device will allow her the enjoy “riding on her own,” while still sitting alongside her parents for safety and peace of mind. Since Abby can’t steer the bike on her own due to her limited control over her hands, our proposed device will allow her parents to control her speed and direction depending on their own bicycling movements.

There are many devices that were designed previously that are along the same lines of what we wish to devise. However, these tandem bicycles were built for healthy individuals who don’t have any limitations when it comes to needing added support. In order to come up with a modification for these devices, we first had to look into what design are already out there, as can be seen the “Other projects and patents” section of this proposal. From these designs we were then able to estimate how much our device would ultimately cost. Our budget for our device will be around $1,000. Since we are in the preliminary stage of design, this number may increase or decrease based on the materials that we will use and the final design of our project.

Introduction

The proposed device is a modified bicycle that will best suit Abby’s needs. Since Abby can’t hold anything with her hands, the device will be controlled by her parents. The device must
be safe for Abby to use since she has limited control of her body. There must be enough support for her upper body as well as straps to hold her in so she won’t fall out since she moves her whole body when she talks. Since Abby’s favorite color is yellow, the bike will be yellow.

The main point of this device is so that Abby will be able to ride recreationally while enjoying a greater degree of freedom than she has had in the past. The bicycle needs to be fun so that Abby will enjoy riding it but also safe so that her health/well-being will not be compromised while riding.

This project’s main constraints are budget and safety. Her parents have stressed that the safety of their daughter comes first and for most so the production of the bicycle must be very safe. Some of the conditions that must be addressed would be the fact that her neck, head, and torso need to be supported. To ensure her safety she must be strapped in so that she does not fall off. Her parents have mentioned that when she talks she uses a lot of body motion so keeping her arms secured on the bike is a must. Since our client lives in Illinois on a big hill, her parents would need to transport the bicycle to the nearby park before Abby could get out and ride. Because of this constraint, the bike also needs to be able to be disassembled and reassembled in order for them to be able to easily transport it. In either case, the bike would have to be safely secured into place before Abby can ride it in order to ensure her safety and so the bike won’t collapse once she is on it. The economic constraints are also a big factor. As can be seen in the budget section below, the majority of the allotted budget will go into the frame of the bicycle and in the necessary supports.

Background (client and disability)

Abby Miller is a 16 year old female with Cerebral Palsy. She has limited mobility as she is restrained to using a wheelchair. Abby has limited control over her arms and legs. When she talks, she moves her whole body. She needs support for her upper body including her torso, neck and
head. Since she usually leans toward the left, support on the left side of her body is unnecessary. A strap over her chest similar to the one on her current wheelchair is also needed to hold Abby into the upright position.

Cerebral palsy is a disease caused by damage to the cerebrum. It can either occur during pregnancy, during childbirth, or after birth for up to three years. When the cerebrum is damaged, the child loses control of certain bodily movements. In Abby’s case, she has limited control over her arms and legs and therefore it would be hard for us to design a bicycle that she would steer or pedal on her own. Understanding Abby’s disease and limitations is key to the design of our device.

The goal of this project is to design a bicycle that Abby can safely use with some independence while giving her parents ultimate control of the bike. The bicycle must be easy to operate as well as being compact enough to conveniently travel from their house to the nearby park. It must also provide the necessary support for her head, neck and torso as required by her Cerebral Palsy.

Other Projects and Patents

After doing research on bicycle sidecars with wheelchair accessibility, there are very few previous designs that were created and available on the market today. On the other hand, there are many previous sidecar designs for bicycles available but lack the wheelchair and handicap accessibility needed for Abby Miller.

The most common sidecar on the market today is the Chariot SideCarrier™. An attractive feature of this design is the ability for the child and adult to be able to communicate with one another. The sidecar hitch attachment proves to allow for the full range of motion for the bicycle, as well as to keep the carrier level with the bicycle. The hitch design for the Chariot SideCarrier™ also allows for the easy attachment and detachment from the bicycle, a very important feature.
necessary for our design specifications. The main problem with this type of design is that the sidecar does not allow persons with wheelchair disabilities to ride in them. The Chariot SideCarrier™ is very narrow in width and does not allow the ease of access for handicap accessibility that Abby needs.

![Figure 1: Chariot SideCarrier™](image)

A wheelchair sidecar built by JEINKEL-HEIMER is a much more practical design for Abby Miller’s needs. This design allows wheelchair accessibility and provides the support and safety needed in this application. An expressed desire of the client was for them to be able to fully interact with Abby while having her safely secured in a wheelchair type seat for a comfortable atmosphere and security. However, this design does not incorporate a chair that is specified for Abby’s needs so a more suitable design would include a similar chair that she uses for everyday activities. This design is much more suitable for the Millers’ overall desires. One of our teams’ alternative designs is based on the JEINKEL-HEIMER prototype because of its ease for wheelchair accessibility and safety of the client.
Objective

The main components of our device are going to be implemented in our design of the seat for the tandem bicycle. Such components include the support needed for Abby’s neck, torso and sides. The “X” chest strap is also a must in our design as it has proved effective as support in her current wheelchair. The device definitely needs to have an easily removable attachment to her father’s bike so that transportation of the device will not be difficult. Our quick release idea will allow her father to detach the tandem from his bike quickly and easily so that he can transport the two devices separately and not as one large bulky unit.

The bicycle should not only be comfortable for Abby to ride in but easy for her to get into as well. By making our device wider in nature, it will be easier for Abby’s parents to get her into the bike. Another neat feature of our design is our independent pedal idea. This will allow Abby to feel like she is riding her own bicycle without actually being in control over where/ when she turns or how fast she is going. This is a safety measure since Abby kicks sometimes when she talks. Even though her feet will be strapped into the pedals to allow for her to pedal easier, it would still
be unsafe if she were to have ultimate control over the bicycle since she doesn’t have ultimate control over her arms or legs.

One of the issues we are currently facing is knowing how many wheels our device will have. In our proposed designs below we show two different designs, one with one wheel and one that would act as a tricycle. Since Abby will still have pedals on her bicycle, we need to ensure that when she pedals, her movement does not affect the overall movement of the bicycle plus tandem device. We also need to ensure that her device will turn as the bicycle its attached to does. Having one wheel would make it easier to turn alongside her father’s bike, however having a tricycle design would allow for better stability.

Since Abby leans to her left, we will have supports for the left side of her body, similar to the current supports found in her wheelchair. Her parents have mentioned that support on her right side is unnecessary so we will not be devising a support for that side. Although we are unsure what material we will use for the supports, we want to make sure that they are comfortable so that Abby can feel safe and secure when riding the bike.

Methods

Design 1:

For this alternative design for the bicycle sidecar, Abby will experience how it feels to ride a bicycle, while being safely secured to meet her proposed needs. In this design, a frame that provides a large surface area would be made in order to make room for her wheelchair type seat that we want to include. A picture of the proposed type of frame can be seen in figure 2 above. The wheelchair type seat that is similar to the everyday chair that she uses would be built into the frame so that there is no sliding or movement of the seat when the bicycle is in motion. Her wheelchair seat would include full neck, side, and head supports so that Abby is fully secure. An
X-type strap that secures her torso, similar to the one she uses for her regular wheelchair, would also be used in this design. Being similar in design to her everyday wheelchair, this device will give Abby the comfort she is normally used to. It will also still allow her to move her neck so that she can be in contact with the driver and to see her surroundings. Extended back and neck supports will be used on the wheelchair seat so that she can rest her head while still fully supporting her. A left lateral support will be introduced into this design since that is the side she normally leans to.

The sidecar itself will have a similar cage that’s seen above, surrounding the wheelchair seat for safety. The front of the cage frame will be on a hinge in order for Abby to get in and out of the wheelchair seat. This will also make it easier for her parents to help strap her in so that she is safely secured in the seat. The sidecar will have one wheel on the right side and will be centered about 6”-10” in front of the center of the rear bicycle wheel for greatest stability. The size of the sidecar wheel will be smaller than the rear wheel, as well as wider to compromise for stability and turning of the tandem bicycle. Lastly, the sidecar will be able to attach and detach from the actual bicycle. This will allow Abby’s parents to transport both the bicycle and sidecar in their truck so that they can take it wherever necessary.

**Design 2:**

In this alternative design, Abby is not very enclosed and would probably feel as if she was riding a bicycle. Since the main component of her bike would be a wheelchair type seat it would feel very comfortable and familiar to her. Since her parents have stressed that she needs full torso, neck and head support some safety features will be added. The wheelchair seat will again have a “X” strap to hold her in, very similar to the one that she uses every day in her normal wheelchair. It will keep her securely in the chair; yet will give her enough mobility to move and look at her surroundings when she is riding in it. Also, an extended back support with sides will make sure
that her neck would never jerk backwards or from side to side. This will enable her to rest her head on one of the sides in case she get tired and would just like to sit back and enjoy they ride. Since Abby primarily looks to her right side, her tricycle will also be attached to the right side of her parent’s bicycles. This will allow her to have the best possible view of their ride. Abby has a tendency to lean to her left side, which means that it is critical that there is support on that side. Currently on her regular wheelchair she has a bar which seems to act as an arm rest. In the bike a sturdier, more supportive side will be implemented. The side might be a little higher than normal to allow for her to lean easier on it.

The idea behind her bike would be in fact a tricycle. This type of design would give her the best possible feeling of being on a bike, yet will give the support and stability needed to ensure that she has a safe ride. The two wheels in the back are going to act in a way like training wheel to ensure that any sudden jerk or movements by Abby would not throw off the balance of her parents driving them. The single wheel in the front is going to be a major component to the entire tricycle. It is going to be attached to the front of her parent’s bike and is going to allow the two to turn. The front wheel is going to be mounted on a circular pivot which will allow the front wheel to turn as the front of her parent’s bike does. Also, to engage Abby in the riding experience, pedals are going to be added to the front wheel frame. They will not be connected to the wheel to ensure that she does not get hurt or feel uncomfortable if the two bikes are moving too fast for her. Instead they are going to be attached either a little higher or lower on the frame and will move independently. They will also be independent of each other in case she moves her legs in the same direction. Her parents have mentioned that she sometimes kicks her legs simultaneously with one another so to make sure she does not get hurt or jam her legs the pedal will act individually. Both of her feet are going to be strapped into the pedals at all times to make sure that she does not accidentally bump or kick her
mother or father in the middle of a ride. Since the pedals are not connected to the wheel if she does not want to engage in pedaling she can use them as a footrest.

Abby’s parents requested that they tricycle could be very mobile and easily transferred from their home to a local park. To accommodate them the tricycle would be as light as possible using metals that are high strength, yet are lightweight. A possible material that can be considered at this point is an aluminum alloy, such as the metal on traditional bikes. This of course would only be for the frame of the tricycle. The chair would be bought separately for safety purposes and then mounted into the frame. Depending on the size of the finished prototype a possible hinge in which the back wheels can be used to collapse and save space in their truck. Finally, the parents would like the tricycle to attach to their regular bikes using a pin and rod set up. At this point the dimension are not clear and the exact placement of the rods have not been decided. Overall, this possible design attempts to make a very fun experience for Abby, yet optimizes safety and practicality for her parents.

**Budget**

For our alternative designs, a frame will need to be built in order to comply with Abby’s physical needs. Our team has agreed upon using aluminum for the frame since it is lightweight for easier maneuverability and handling. We have also determined that using a similar type of wheelchair that Abby uses throughout the day could be incorporated into the frame of the sidecar for comfort and safety. Full body, neck and head supports will also be built into the chair design so that her safety and support requirements are met. A wheel, similar to that of the rear wheel of a bicycle, will be used for the sidecar. This wheel will be thicker and smaller in order to keep the wheel from slipping or skidding when in use. A rough estimate for the parts cost is seen blow in the table.
Table 1: Parts List for Project

<table>
<thead>
<tr>
<th>Parts List</th>
<th>Estimated Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminum Stock</td>
<td>$150.00-$200.00</td>
</tr>
<tr>
<td>Wheelchair-Type Seat</td>
<td>$300.00-$400.00</td>
</tr>
<tr>
<td>Torso/Neck/Head Supports</td>
<td>$100.00-$200.00</td>
</tr>
<tr>
<td>20” Tire for Sidecar</td>
<td>$30.00-$50.00</td>
</tr>
<tr>
<td>Attachable Hitch (2)</td>
<td>$40.00-$60.00</td>
</tr>
<tr>
<td>Miscellaneous Hardware</td>
<td>$60.00-$80.00</td>
</tr>
</tbody>
</table>

The aluminum stock is estimated to cost around $150.00-$200.00 for the frame and other accessories to the sidecar. The wheelchair-type seat is still a very rough estimate since we are still working with the client to determine the cost of the same type of wheelchair seat that Abby uses. The torso/neck/and head support costs are estimated at around $100.00-$200.00 and are still being researched at this time. The estimated price for the attachable hitch’s to be used on the bicycle sidecar are also still being researched at this time. The 20” tire is estimated around $30.00-$50.00. We have allotted $60.00-$80.00 for miscellaneous parts and accessories for the sidecar as well.

**Conclusion**

Building a bike for Abby Miller is something that is very important not only to her, but also her family. She used to have a pull behind model when she was younger, but since he has grown up and become bigger she can no longer use it. Creating a bicycle that fits her wants/needs yet abides to what he parents believe is safest for her would be very much enjoyed by her. After collaborating with her parents it was decided that an attachable bicycle/tricycle would be created and developed so that she can ride along side of her mother or father. This would allow her parents to ensure that
she is safe at all times and maximize her experience. The two would be able to talk to one another directly while enjoying being outside.

Our groups design is similar to what a ride along on a motor cycle would be like. Abby would sit beside the bike without having to exert any effort in moving. Since Abby has limited control of her legs the group thought that it would be best if her tricycle was dependent on the actual bike rider’s physical effort to move. This would allow Abby’s mother or father to control speed and direction to make sure that no harm would come to either of the riders. The seat that Abby would be sitting on is going to be very similar to her wheel chair set up that she uses every day. Instead of a traditional bike seat a modified wheelchair seat will give her torso, neck and head the adequate support that her parents requested. She will be completely strapped in to the seat in the same manner that she is in her wheel chair.

To ensure that there will be no chance that the bike will tip over an idea of a tricycle layout will be used so that she will still have the same feeling that she is on a bike from the front, but the two back wheels will give the support that is needed. To simulate a pedal motion for Abby to make her more involved in the riding experience, two pedals are going to be added to her front wheel. Since we do not want her legs to get caught or jammed the pedals will be independent of the wheel itself. They are going to be attached to the frame in a way that she can pedal when and if she wants to. Since Abby’s parents need to transfer their bike and Abby’s bike it is going to be as light as possible to allow only one person to lift it into a truck bed. Also, a quick release pin mechanism is going to be used to attach the bike to Abby’s bike. This is going to allow her parents to have a very easy time assembling and dissembling it when they go for a bike ride.
Like all projects the budget is always a main concern. After doing some research and putting together a rough idea of what our design might be an estimate of $1,000 dollars was made. The majority of the cost would be going to the wheelchair seat and the supports. Since these two aspects are a large safety concern cutting corners to save some money is out of the question. Of course as the optimal design is created a more specific budget will be created and finalized. Making a bicycle side car for Abby is something that will undoubtedly make her very happy. It will be something that she can use for many years to come and will be easy enough for her parents to help her with.