Product Design Specifications

Tandem bike for person with Autism

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Function: (a general statement of what the device is supposed to do): The PDS should begin with a brief, concise paragraph describing (in words) the overall function of the device. In the initial stages, this will be the problem statement, and will become more specific as you decide on a final design.

A family has requested that a tandem bike be constructed so that their adult autistic child can go for rides with an attendant. The bike should provide the autistic individual a physical workout while supplying them with a positive feedback system that encourages them to keep pedaling. The bike should also be fully operated by the attendant to the autisitc individual with an electric motor to aid in their pedaling.

Client requirements (itemize what you have learned from the client about his / her needs):.

- Support the weight of two adults
- Very stable
- An electric motor as part of the front half of the bike
- No gears exposed on the back half of the bike
- A harness to secure the autistic individual in the back seat of the bike
- Some sort of feedback system to reward the autistic individual when they help pedal the bike
- Resistance to the back pedals to keep the autistic individual physically active
- No steering or brake capabilities for the back seat

Design requirements: This device description should be followed by a list of all relevant constraints, with the following list serving as a guideline. (Note: include only those relevant to your project):

1. Physical and Operational Characteristics

a. *Performance requirements*:

The product should have the ability to give the autistic individual the full experience of riding a bike, but in a safe manner. The bike also needs to have an electric motor to power the front half of the bike for the attendant to use whenever necessary. The attendant should also have full control of the bike for steering and stopping. The back half of the bike should be intended for the autistic individual. This half needs to include some sort of resistance to the pedals, so they can be physically active while riding. The back half of the bike should also include a harness as part of the chair to safely secure the autistic individual to the bike. Finally, it would be desirable for the autistic individual to be rewarded when they pedal through some sort of feedback system (ex. light turns on).

b. *Safety*:

The device must be able to support the weight of the autistic individual and the attendant along with them. A rough estimate of the overall weight would be in the ballpark of 400-500lbs. The device also needs a harness for the back seat, to keep the autistic individual from falling off of the bike. Next, the device needs to be very stable, so the bike cannot tip over while driving. Finally, gears cannot be exposed in the back half of the bike near the autistic individual, as they could get their fingers or other body parts caught in it.

c. *Accuracy and Reliability*:

The device should be reliable and have the ability to withstand repetitive use from the users without breaking down. The electric motor on the device should be able to hold a good charge to allow the users to go on rides of longer distances if desired. Finally, the seats on the device should cause no pain or discomfort to the users, while still maintaining a very high level of safety.

d. *Life in Service*:

The device should run properly 3-4 times a week if necessary. The battery should last long enough for a single trip that may take up to a few hours.

e. *Shelf Life*:

The ideal shelf life of this device will be throughout the client's lifetime. The current goal is for the bike to last 20 years if maintained correctly. The electric portion of the bike may have to have to undergo small maintenance earlier.

f. *Operating Environment*:

The device is mainly going to be exposed to a normal outdoor environment in the spring, summer, and fall months in Wisconsin. It is expected that the bicycle will only be used on days of nice weather, however it should be able to withstand some rain and wind if poorer conditions intervene a sunny day. While stored in the winter months, the bicycle may be exposed to very cold temperatures, which it must withstand as well. The bicycle should be able to withstand the weight of two fully grown adults (up to 500lbs).

g. *Ergonomics*:

The device is to be operated electrically, which will remove most worries about the force required for an individual to have to bike two fully grown adults around. However, this device still needs to act in a safe, efficient manner while transporting the two people. The device should be easy to control via some type of steering mechanism. The front of the bike, where the operator is must be further than an arm's reach away from the back of the device where the client will be to avoid potential physical altercations between the two.

h. *Size*:

There is no exact maximum length of the device at this moment, only the fact that it must be able to fit inside a garage to be stored. The minimum length must fulfill the need assessed above; that the client will not be able to reach the person operating the bicycle. The device must also must be large enough to comfortably seat the client, who is approximately 6’0 and 230lbs.

i. *Weight*:

There are currently no established restrictions on the weight of the tandem bike. However, Noah is about 230lbs and the staff biker is also an adult and these weights, along with the other components of the bike, must be considered in the design.

j. *Materials*:

Currently there are no restrictions on the kinds of materials we can consider for potential design solutions.

k. *Aesthetics*, *Appearance, and Finish*:

The aesthetics of the tandem bike design should heavily consider safety. All potentially injurious components (i.e. chains, edges, or corners) should be elegantly concealed or padded.

2. Production
Characteristics

a. *Quantity*:

This is a custom design project for a single client. Only one unit is needed.

b. *Target Product Cost*:

The team has not yet established a target cost, we are currently in the process of researching and conceptualizing design ideas. Although it is too early to say, manufacturing costs should not be high as the team will utilize the TEAM LAB to manufacture the design. A brief competing designs research suggests that tandem recumbent bikes are approximately $3000.

3.
Miscellanes

a. *Standards and Specifications*:

There is no FDA approval required for this product, however an IRB should be checked in order to have a person using the device. Furthermore, HIPPA standards should require the team and the client to be confidential unless otherwise specified by the client.

Normal bike standards should be established such as mirrors, helmets, and turn signals. Either in the form of lights or hand gestures. This is stated by the State of Wisconsins' Department of Transportation specifically in The Wisconsin State Legislature Bicycle[340.01(5)].

b. *Customer*:

The client enjoys music and being active. The client also can not handle loud noises and sudden distractions. Also, comfortability to the belt being used is important

c. *Patient-related concerns*:

- Concerns related to autism should be taken into account. This includes interaction with the device and the user. Furthermore, storage of this bike needs to be able to fit in a car.

d. *Competition*:

Many tandem bikes exist such as TerraTrike and tandem e-bikes such as RunAbout bikes. Trailers

from Thule also exist for children and adults. However, none of these designs have been custom fit to our clients needs, so no current technology exists for our user.