HANDICAP ACCESSIBLE SIDECAR

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ABSTRACT

The life of some adult TBI(traumatic brain injury) patients is very limited in physical ability and the capacity to participate in activities such as going for bike rides. Although there are adult sized attachments and recumbant bikes on the market, none of them fit the need for that of an adult that lacks normal mobility, but has enough ability to still participate. These current designs are mostly passive, do not provide adequate stability required for TBI patients, and are not cost effective. Four potential designs were proposed to create a safe, interactive, and cost effective design for a disabled adult. The final design is composed of steel rods welded in a tricycle formation that attaches to the seat of a standard bicycle. This two wheeled attachment includes features such as arm bars, shock absorbent tires, and a separate drivetrain allowing for passenger participation.

BACKGROUND

Traumatic Brain Injuries (TBIs)
- ~1.7 million people in the U.S. sustain a TBI each year
- Brain injuries can create different mental and physical problems depending on severity

Physical Therapy and exercise
- Patients with physical impairments can improve their abilities through physical therapy and exercise
- Not all are able to return to a preinjury status

Client
- Suffered from a TBI after an accident
- Has retained some limited mobility
- Can have seizures triggered by too much movement of the head

MOTIVATION

Create a bicycle attachment suited for the needs of TBI or other limited mobility individuals. The design is to be engaging, safe, and cost effective. Current on the market designs fail in some of these categories.

DESIGN CRITERIA

Client and Design Requirements
- Withstand conditions of terrain/ smooth ride to prevent injuries
- Must stay within a $1,000 budget, $500 preferred
- Able to fit in the trunk of minivan
- Sidecar must detach to the side or behind the bike
- Put pedals on sidecar

FINAL PROTOTYPE

Double framed trailer:
- Pedals attached with straps as a form of physical therapy
- Complete drive train
- Sidecar attached to the seatpost of bicycle
- Seat has approximate height off the ground of a Tsunami rigid frame wheelchair
- Grab bars on seat to help stabilize our client
- Wide wheels operating at a lowered PSI to reduce strain on client

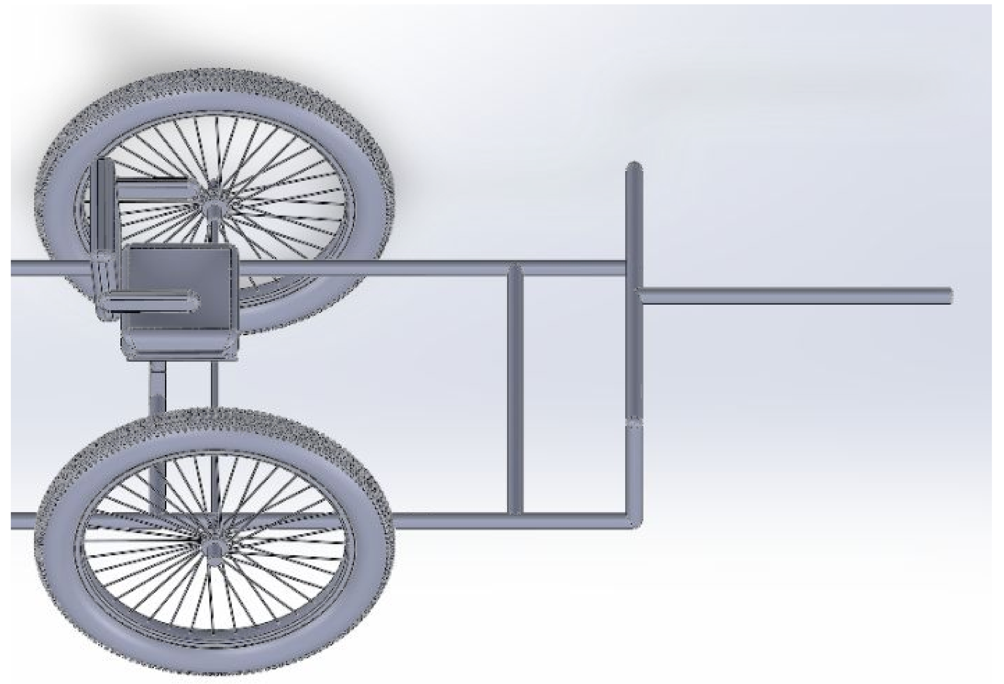

Figure 1. Solidworks assembly of preliminary design of prototype

Specifications:
- Height: 31 & 9/16 in
- Length: 90 in
- Total Prototype Cost: $170.76

Materials:
- 3 Steel Conduit Pipes 1in diameter by 10 ft
- Steel Rod, 7/16 in. diameter
- Threaded Steel Rod, 3/8 in. 5/16 diameter
- Tractor Seat 14x14in
- Cog, 7 & 3/16 in. diameter
- Front and Back Mountain Bike Tires, 25.5 in. diameter and 25 in. diameter
- 2 Bike Chain
- Ball Bearing, 2 in. diameter

Figure 2: The finished prototype connected to the client's bike

TESTING PROCEDURE

- **Spring Damper Test-** Estimation of the steady state deflection of the seat with our client's weight as the external force on the system.
- **Ride Test -** Two team members rode the prototype while both pedaling in a straight line through ECB Lobby. Then the bike was tested doing slight turns of no more than 5 degrees.

Figure 3: Measurement of displacement in test 1

Figure 4: Morgan and Shelby demonstrating the Ride Test

- **Displacement Test-** Increasing weight amounts were put on the seat up to 195lbs. Before and after each weight the difference in the positive arch from the parallel frame bars was measured

RESULTS/HAND CALCULATIONS

Mass-Spring/Damper model of seat

$\sum Fx=13.6(kg)x''+62.837(Ns/mm)x'+129.034(N/mm)$

$k=129.034(N/mm)$

$c=62.837(Ns/mm)$

- Estimated ~5mm steady state deflection

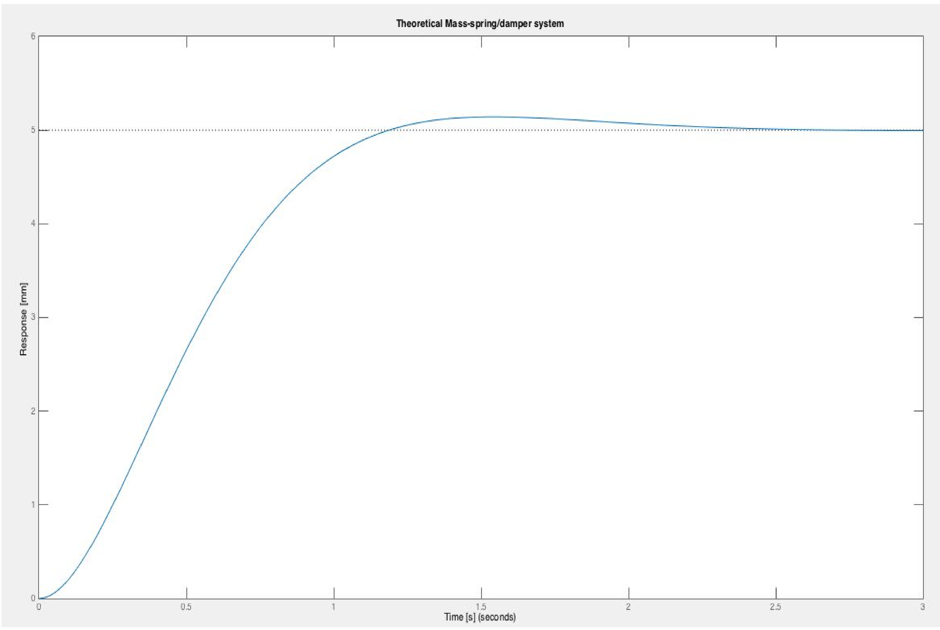

Figure 5 . Mass-spring/damper model of the seat's deflection

Ride and Comfort

The ride was very smooth during the test. Although the structure was overall stable, the seat "a bit rocky".Our subject was significantly shorter than our client so the pedal rotation was not an accurate test. Along with the height difference the offset of the pedals made rotation more difficult.

Structural Integrity

The steel frame had minimal displacement of 6.35 mm for the maximum load of 195lbs during static testing. With the dynamic structure the axle support showed an additional displacement of 3/4in.

FUTURE WORKS

- Armrests for self support/ seat belt/seat improvements
- Foot holds on pedals
- Improved clamp for angle limitation
- Revolving seat for ease of getting on
- Sealable container for holding medical supplies
- Improved axle
- More Testing

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