

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 recumbent 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. 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 of arm bars, shock absorbent tires, and a separate drivetrain allowing for passenger participation. Three separate methods have been proposed to make entering and exiting the device safer and more convenient for the passenger. These include a swivel chair design, slide bar design, and dip bar design with the latter two requiring change in composition of the frame.

BACKGROUND

- 1.7 million people in the U.S. sustain a traumatic brain injury (TBI) each year [1]
- Physical therapy helps patients make great improvements towards normal physical ability
- Current handicap accessible sidecars are passive and expensive
 - Walk & Bike Company's extra large special needs bicycle is \$980 [2]
 - Duet wheelchair bicycle tandem is \$4,750 [3]
- Active pedaling can improve physical ability and reduce anxiety and depression [4]
- Active design is suited for TBI, autism, cerebral palsy, and Angelman's syndrome patients



Figure 1. Prototype from fall 2016.

- Last semester's prototype
 - Trailer design
 - Steel conduit frame
 - Too long for pedaling
 - No armrests
 - Seat belt
 - 13in step height

DESIGN CRITERIA

- Detachable from bike for storage
- Fit in back of minivan
- Seat height of wheelchair
- Armrests and seat belt
- \$1000 budget, \$500 preferred
- 7in step height for entrance
- Storage space for medication
- Pedals that stabilize feet
- Withstand conditions or terrain/ smooth ride to prevent injuries

FINAL DESIGN

Double framed trailer:

- Pedals attached with straps as a form of physical therapy
- Complete drive train
- Sidecar attached to the seat post of bicycle
- Seat has approximate height off the ground of a Tsunami rigid frame wheelchair
- Grab bars and seat belt on seat to help stabilize our client
- Wide wheels operating at a lowered PSI to reduce strain on client
- Custom machined axle to provide maximum support within existing 16" wheels

Specifications:

- Detachable bike trailer
- Detachable/adjustable seat
- 1 in diameter steel frame
- Burley Travoy hitch attachment
- 40 lbs with 30 lb detachable seat
- 81.5 in length
- 36 in width
- 16 in seat height
- 8 in step height
- 16 in wheels
- \$480

Materials:

- Burley Travoy hitch and hitch connector
- Tractor seat with slide bars
- ¼ in pedal bar
- 105 in of 1 in steel pipe
- 36 in of steel plate
- Royalbaby kids bike
- 5/8 in diameter axle
- Bike chain
- 5/8 in self aligning pillow blocks



Figure 2. Spring 2017 model.

TESTING PROCEDURE

- Jackknifing:
 - Measure maximum angle between bike and trailer that the bike can start riding from
- Positive arch/Axle displacement test:
 - 210lb load applied to seat
 - ImageJ used to analyze change in angle between positive arch and axle
- Ride test:
 - Overall comfort of ride on lakeshore path and paved surfaces

RESULTS & DISCUSSION

Jackknifing:

- Able to begin riding bike with trailer turned up to 90°

Positive Arch/Axle Displacement:

- 0.992° average displacement
- Standard deviation of 0.211
- 0.1 < P-Value < 0.05
- Do not reject null: no significant displacement

Ride Test:

- 5'3" height, 135lb weight subject to simulate client
- Smooth ride and stable seat
- Bending, catching, and dragging pedals
- Able to make turns on sidewalk
- Space on sidewalk for passing bikes and pedestrians

Size:

- 50.79 in W X 107.09 in L X 49.41 in H Honda CRV trunk
- 36 in W X 81.5 in L X 33 in H Trailer

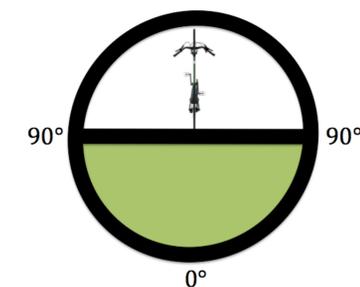


Figure 3. Allowable trailer angles.

FUTURE WORKS

- Strengthen pedal bar
 - Thicken rods
 - Center pedals
 - Raise pedals
- Add additional safety accessories
 - Bell
 - Fenders
 - Reflectors

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REFERENCES

- [1] "Facts About Traumatic Brain Injury", *Brainline.org*, 2016. [Online]. Available: <http://www.brainline.org/content/2008/07/facts-about-traumatic-brain-injury.html>. [Accessed: 09- Oct- 2016].
- [2] "TBI: Severe Traumatic Brain Injury Symptoms | Severe Brain Injury | Symptoms of TBI", *Traumaticbraininjury.com*, 2016. [Online]. Available: <http://www.traumaticbraininjury.com/symptoms-of-tbi/severe-tbi-symptoms/>. [Accessed: 17- Oct- 2016].
- [3] S. R.J, "Benefits of sport and physical activity for the disabled: implications for the individual and for society. - PubMed - NCBI", *Ncbi.nlm.nih.gov*, 2016. [Online]. Available: <https://www.ncbi.nlm.nih.gov/pubmed/1832786>. [Accessed: 17- Oct- 2016]