Fast and Furious: High Speeds at High Hopes Preschool Progress Presentation

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Problem Statement

Children who lack the freedom of independent mobility experience resulting negative cognitive effects such as poor depth perception and cause and effect reasoning. These same children also unfortunately tend to be ostracized by their peers, preventing the development of valuable social skills.

Primary Objective

Mainly, we seek to help the children gain age-appropriate individual control of their mobility. Granting them the ability to move about on their own will help them with:

- Conceptualization of cause and effect
- Depth perception
- Cognitive development
- Social development

Needs Assessment

Patient :

- Must provide independent mobility for the child
- Needs to accommodate children of different sizes (up to 70 lbs)
- Must not startle the child during acceleration
- Needs to provide multiple options for acceleration for children with different needs

Provider:

- Must be able to easily adjust seat for child
- Must be able to easily access battery for charging
- Motor controller must be easily accessible
- Must be able to adapt car for distinct needs of child
- Must have easily switchable acceleration mechanisms
- Must be easily sanitized to prevent potential spread of germs between children

System:

- Will be a powered mobility device
- Can't compromise original outer structure
- Additional parts for the car must not cost over $200
- Time to fully charge battery should be 8-12 hours
- Total run time will be 1-2 hours
- Charge monitor to indicate battery level/when charging is needed

Solution Description

A power wheels car (6-V battery powered ride-on) with modular components and attachments which will support a variety of conditions. Our car is suited for children younger than 5 years and will have:

1. Safety Features
    a. Torso harness, foam padding, postural supports, possibly a parent handle and brake
2. Plug and Play Inputs
    a. Button to accelerate, steering wheel, handle bars, pressure controls
3. Motivational Appeals
    a. Colored inputs, music, lighting

This week:

4. Safety Feature
    a. Motor controller installed
5. Postural Support
    a. Built back/head rest

Measurements/Observations to Consider

Measurement	Modification Effect
Seat is not easily adjusted by the provider external to the car	3D printed hinged axle adaptation that can be accessed from the exterior of the car
Easily adjust seat harness	Make slots in the back/head rest to loop the harness through
Some children’s torsos will be longer than the height of the stock car seat	Create additional height for the seat
Additional seat height must be able to support a child’s head	Make supports for the additional seat height

Noteworthy Progress

- Designed an initial unscrewing mechanism for the seat
- Shaped a back/head rest out of foam
- Installed motor controller
- Contacted Nancy about testing her kids in our car for analysis- waiting on results from chat with Dr. Walker
- Planned kill switch and back steering design

High Hopes Study- Powered Mobility Checklist

Scoring (adapted from Furumasu 2016)

0	Task no attempted
1	Maximal hands-on assistance on switch with verbal cueing (51-75% assist)
2	Moderate hands-on assistance on switch with verbal cueing (26-50% assist)
3	Minimal hands-on assistance on switch with verbal cueing (25% or less assist)
4	Direct stand-by guarding with verbal cueing with occasional minimal assist to redirect
5	Verbal cueing only
6	Age appropriate supervision

Skills

	Score
Turns switch on and off	
Demonstrates concept of cause and effect (realizes that activating switch is causing movement of car – communicating verbally, expression, or action)	
Demonstrates "Stop" and "Go" concepts; follows directions of releasing switch at verbal cue of "stop" and pushing switch with verbal cue of "go"	
Maintains contact with switch for a minimum of 5 seconds	
Pushes switch to engage car in motion for 5 seconds	
Navigates car in forward direction for 10 seconds	
Looks in the direction of movement	
Turns a 90 degree corner to the left	
Turns a 90 degree corner to the right	
Navigates towards a toy, stops to play with toy	
Navigates towards a peer, teacher, or parent; stops to interact with individual	
Stops the car on command after engaging car in forward motion	
Stops after bumping into an obstacle	
Stops spontaneously to avoid stationary objects	

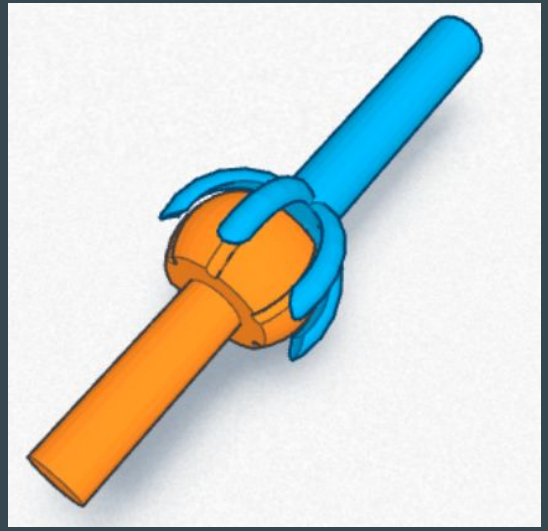
Current Goals

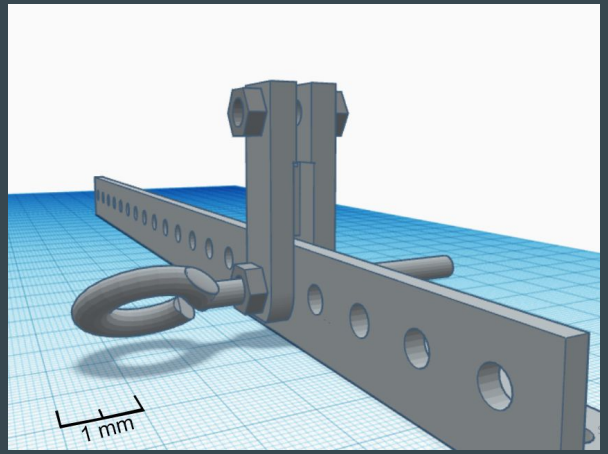
- Complete kill switch and back steering design
- Materialize unscrewing mechanism
- Create foam molds for hip alignment, leg flair restriction, headrest
- Attach harness
- Test additional saddle pieces
- Construct multiple buttons

Milestone	Deadline	Status
Track construction- amanda and nick	Tues Feb 07	Completed
Total seat modification- amanda and nick	Tues Feb 07; Tues Feb 21 Wed Feb 22	Completed
Leg/hip padding- amanda and taylor	Tues Feb 14; Fri Feb 24 Fri Mar 3' Fri Mar 17	Not started
Steering wheel modification- taylor and nick	Fri Feb 17; Fri Mar 3 Fri Mar 17	Not started
Motor operation/wiring- will	Tues Feb 21; Thur Mar 2	Completed
Kill switch and back handle- will, amanda, nick	Fri Feb 24; Fri Mar 17	In Progress
Headrest construction- amanda and taylor	Fri Feb 24; Fri Mar 3; Fri MAr 17	In progress
Armrest construction- amanda and taylor	Tues Feb 28; Fri Mar 17	Not started
Harness attachment- will	Tues Feb 28; Fri Mar 17	Not started
Acceleration options (buttons, head, handlebars, pressure sensors)- taylor, maybe amanda and nick	Fri Mar 17	In progress
Car test-ready	Fri Mar 24	Not started

Design Updates - Seat

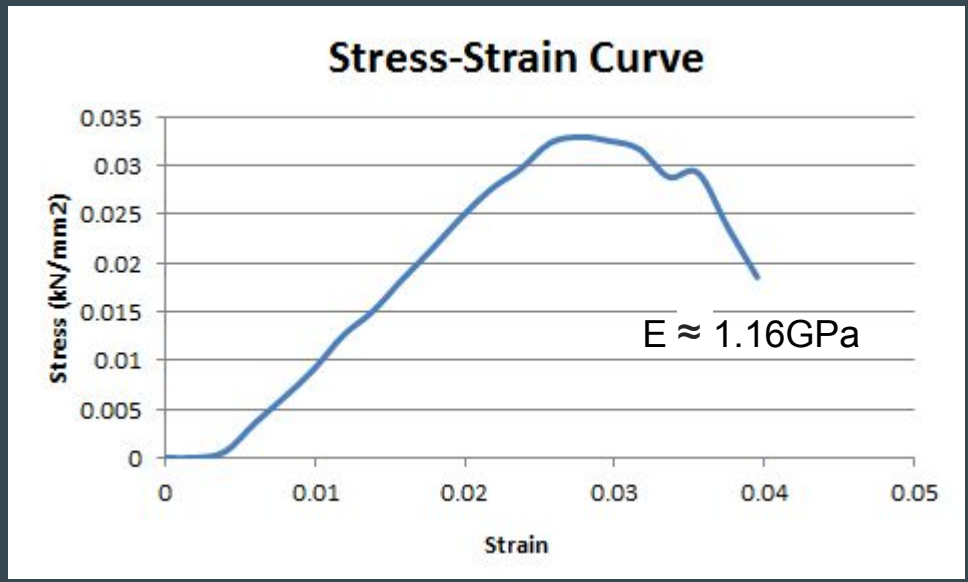
- Hinged axle adaptation to be 3D printed
- 1mm diameter ball bearings
- 9.2mm interior diameter male part with 6 slots
- 10mm exterior diameter female part with 6 arms
- Variable lengths of attached rods, will allow at most 90 degrees of tilt
- Seat tracks 260mm in length and 356mm apart, parallel
- Printed saddle pieces 66.3mm in height





Compression Testing

Pressure (N/m2) x Minimum cross area (m2) = Force (N)

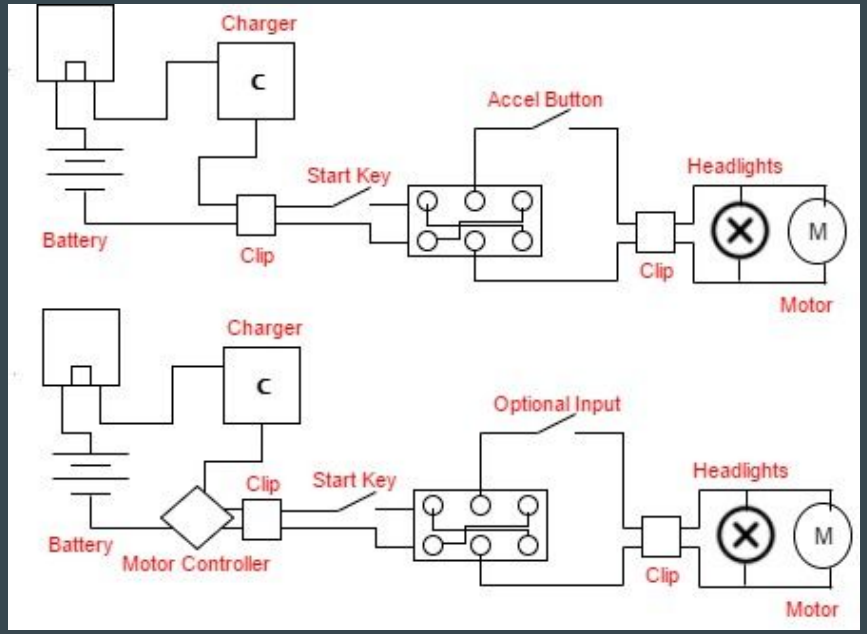


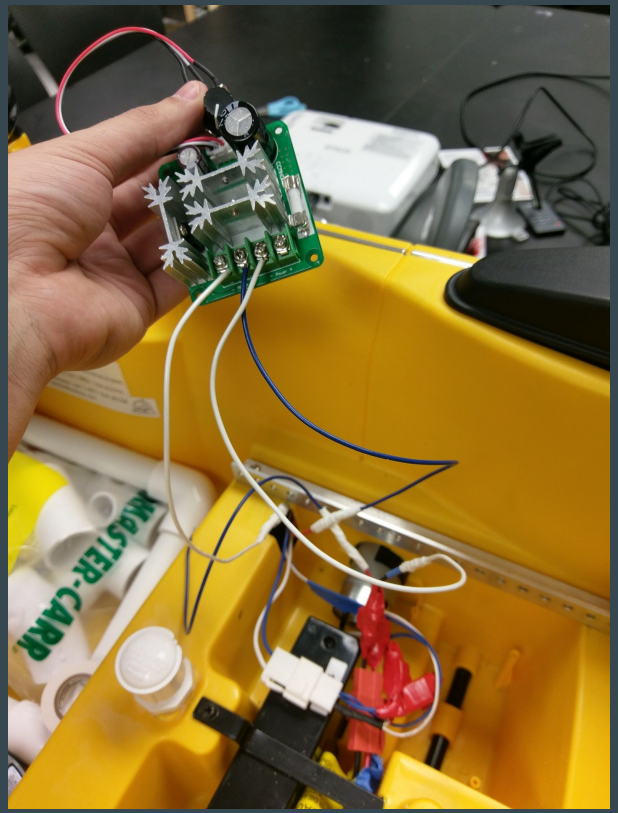
Calculated force: 2561.22 N (575.81 lbs)
Tested: 1602.25 N (360.22 lbs)

Approximate fill level for print ~62.5%

Fracture in piece follows vertical grain of 3d printed material

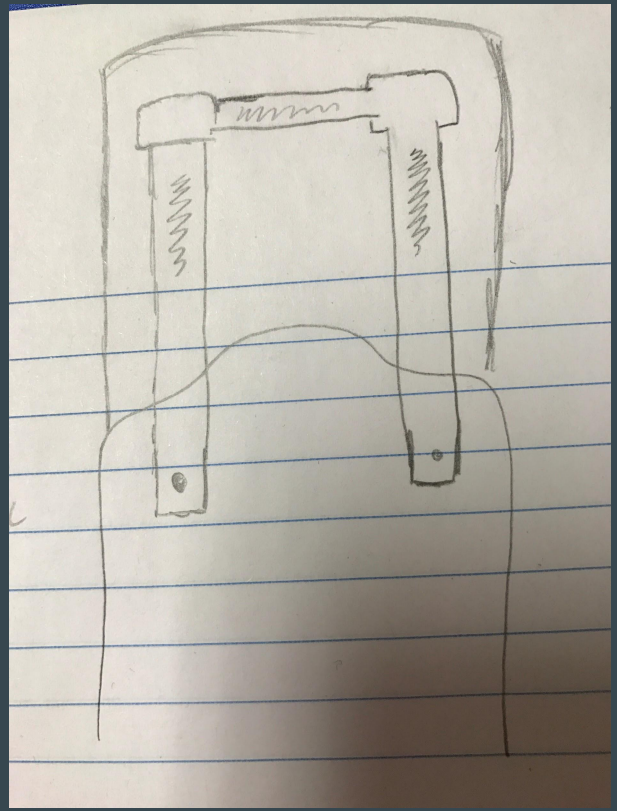
Design Updates- Circuit





Design Updates - Head Support

- Foam cut a head-rest/back extended to go above chair
- Height of head-rest: 30.2 cm
- Made a head-rest support to attach
- Support made of 3 PVC pipe pieces and two 90 degree elbows
- Length of middle PVC pipe: 16.3 cm
- Length of side PVC pipes: 28.2 cm
- Support will be velcroed to the head-rest and screwed into seat



Future Goals

- Installation of motor controller
- Update of pending circuit diagram to account for new wiring
- Shaping and attachment of foam correction blocks for legs and hips
- Acquisition of materials necessary for steering wheel adjustment
- Installation and customisation of safety harness, headrest, and armrest
- Installation of kill switch and multiple activation methods

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Comments

- Next week we’re meeting at noon. No progress report.
- Check notes from each slide and apply