Team 5
Final Presentation

ACCESSIBLE LAPTOP DESK FOR JULIA
ONE ARMED DRIVE MANUAL WHEELCHAIR FOR DANIELLE
AUTOMATIC LIFT SYSTEM FOR DANIELLE

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Overview

- Client Information
- Client’s Needs/Purpose
- Design
  - Accessible Laptop Desk for Julia
  - One Armed Drive Manual Wheelchair for Danielle
  - Automatic Lift System for Danielle
- Budget
- Current Work
- Future Work
- Acknowledgments
Julia Hall

- 11 year old student at Mansfield Middle School with Cerebral Palsy
- Uses electric wheelchair to get around in her classrooms and school hallways
- Can open doors and use the elevator independently.
- Can pull up under her school’s tables and student desks to be included in groups during class.
- Ability to get out of her chair by herself.
- Doesn’t use her wheelchair all the time at home
- In many of her classes, Julia finds it easiest to use her laptop to type out her responses and has a computer program to read them out for her.
Danielle Giroux

- 11 year old female with Cerebral Palsy
- Lives in Tolland CT with parents and siblings
- No use of her left hand
- Limited communication
- Recently underwent back surgery to improve her posture while using electric/manual wheelchair
- Creating a One Armed Drive Manual Wheelchair and an Automatic Lift to assist Danielle
Cerebral Palsy

- Caused by damage to motor control centers of the brain during pregnancy, childbirth, and up to 3 years of age
- Limits movement and posture, accompanied by disturbances of sensation, depth perception, and communication
- Characterized by abnormal muscle tone, reflexes, or motor development/coordination
Julia currently uses a wheelchair tray that slides on and off her chair. She needs a teacher to help her put it on and take it off.

A teacher also has to carry her laptop for her and set it up on her tray when she needs it.

Therefore, her teacher asked us to make a electronic tray that will attach to the side of Julia’s wheelchair that is easy to operate so she can use it at the push of a button.

The tray should also securely hold a laptop when in desk position and hanging position.
Project Requirements – Julia’s Laptop Tray

- Tray must attach to right side of wheelchair.
  - Joystick control on left
- Tray must be easy to operate, so our client can use it independently.
- Ability to attach a laptop, which must be secured and protected when the tray is in any position
- The ability to detach the laptop to charge overnight
- The ability to remove the entire tray easily as needed
- The device must be safe to operate in a middle school environment.
Julia’s Tray

- Tray will be cut from a polycarbonate sheet 0.236” thick.
- It will be edged in rubber.
Tray will be hinged to a second rectangular piece of polycarbonate, which will be clamped on the right arm of the client’s wheelchair.
Julia’s Tray Attachment Continued

270 degree Hinge

Rectangular arm support piece

Clamp

Chair arm (Front view)

Front View

270° hinges

Clamp
Julia’s Tray Movement

- Tray will swing from the side of the chair out $270^\circ$ to desk position.
- When hanging down, the laptop will be protected on the inside of the tray (toward the wheelchair).
Why Use a Stepper Motor?

- Its position can be accurately controlled since its rotation is divided into a large number of steps.
  - 200 steps for a 360 degree rotation would mean a 1.8 degree rotation per step.
- Stepper motors also fail in a fixed position
- A bipolar stepper motor will be used.
  - Easily programmable to go in two directions.

In Our Design..

- Calculated that around 775 oz-in of torque is needed to move tray with laptop.
- www.kelinginc.net
  - Bipolar stepper motor with 1200 oz-in of torque
Controlling Julia’s Laptop Tray

- We plan to power our device by hooking it to the battery that powers our client’s electric wheelchair.
- Physical controls will include two switches for our client
  - System on/off
  - tray up/down
- Our motor will be controlled by an electric circuit which will include a microcontroller
  - Microcontroller will help interpret the position of the control switches and have the motor move the tray accordingly
Purpose – One Arm Drive for Danielle

- The patient in this project does not have motor control in her left hand, which makes it difficult to propel and maneuver a manual wheelchair.
- The patient uses a motorized wheelchair to move around her school, but the heaviness and bulkiness make it difficult for use within the home.
- Danielle and her family would like to use the manual wheelchair within the house or in other informal settings.
- The final product will allow the patient to control a manual wheelchair with simply one hand.
- It will also have an easy braking system that will allow the patient to stop simply using her right hand.
Project Requirements- One Arm Drive

- Wheelchair must be easily controlled by solely the right hand
- Manual, not motorized
- Collapse to less than 8 inches for portability
- Lightweight
- Easy braking system
- Ability to disengage to allow parents to push from behind
- Proper seat support to maintain posture for client
- Safety: restraint system for use in motor vehicle
Design – One Arm Drive for Danielle

- Invacare Cylindrical Lever Drive (CLD) System
- Fits on Invacare 9000 Series Wheelchairs (non-folding)
- Operates using a simple forward pumping action to propel wheelchair forward
- Client can change between forward, neutral, and reverse movements via a gear box
- Operator controls steering by moving the arm to the left/right
- Challenge: team must attach this system to a folding wheelchair
Design – One Arm Drive for Danielle

- Team found Invacare Cylindrical Lever Drive (CLD) system at NEAT Marketplace, as well as folding wheelchair frame
- Must attach CLD system to folding wheelchair and focus on proper seating position and safety features
Design – One Arm Drive for Danielle

- Contact client’s physical therapist to discuss proper seating position
- Head rest, seat, foot rest, pummel, and hip guides all purchased at NEAT marketplace
- These accessories will be attached to the wheelchair in locations to support proper posture
Design - Safety Features

- CLD system incorporates a braking feature
- Operator simply pulls back on the drive arm to stop movement of wheelchair
- Brake pad attached to drive arm will rest against wheel to hinder movement
- Restraint system will be added to wheelchair for use in motor vehicle
Purpose – Automatic Lift System for Danielle

- Currently, Danielle has no way of getting buildings that are not handicap accessible.
- Lift system will allow Danielle to enter and exit a non-handicap accessible building with two to four steps.
- Eliminate the need for her parents to physically carry Danielle and her wheelchair.
- Client is looking for a portable, relatively lightweight solution that will be ready to use by the end of March.
Design – Automatic Lift System for Danielle

- Two motorized jacks
  - Lift platform
  - Controlled by remote
- Foldable ramp
  - Extends onto porch
  - Adjustable support rods
- Adjustable threshold ramp to enter/exit home
  - Also used to get client onto platform
- Component will be secured using a system of hinges and latches
Design – Automatic Lift System for Danielle

- ¼” Thick Aluminum
  - 31 lbs for platform and ramp component
- Aluminum Support Rods
  - Adjustable from 6” to 18”
  - Ideal for multiple steps
- Base Assembly
  - Hide jack components and motor
  - Easy to attach wheels for transportation
- Threshold Ramp
  - Aluminum
  - Adjustable
Motorized Jacks for Danielle’s Lift System

- Two 30” motorized jacks powered by BAL products scissor jack power packs
  - Both jack’s controlled by one remote
  - Relatively lightweight
- Jacks will sit within the base assembly of the lift when not in use
## Preliminary Budget

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Cost</th>
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</thead>
<tbody>
<tr>
<td><strong>Julia’s Tray</strong></td>
<td>Polycarbonate Sheet</td>
<td>$35</td>
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<tr>
<td></td>
<td>Stepper Motor</td>
<td>$129</td>
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<tr>
<td></td>
<td>Clamps</td>
<td>$40</td>
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<td></td>
<td>Specialized Hinges</td>
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<tr>
<td><strong>Danielle’s OAD</strong></td>
<td>OAD System</td>
<td>$70</td>
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<td>Manual Wheelchair</td>
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<td></td>
<td>Headrest/Footrest</td>
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<td>Specialty Seating</td>
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<td><strong>Danielle’s Lift</strong></td>
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<td>Motorized Power Packs</td>
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<td>Hinges and Latches</td>
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<tr>
<td><strong>Total</strong></td>
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<td>$749</td>
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# Progress on Julia’s Laptop Tray

## Current Work
- Development of tray prototype to finalize measurements
- Ordering of Parts
- Research on microcontrollers

## Future Work (End of Semester)
- Order all necessary parts
- Have polycarbonate tray cut to correct dimensions
- Have microcontroller programmed
## Progress on Danielle’s One Arm Drive

<table>
<thead>
<tr>
<th>Current Work</th>
<th>Future Work (End of Semester)</th>
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<tbody>
<tr>
<td>• Purchased all parts from NEAT Marketplace ($125 total)</td>
<td>• Have One Arm Drive system fully attached to wheelchair</td>
</tr>
<tr>
<td>• Close contact with physical therapist to discuss proper seating position</td>
<td>• Focus on seating position and restraint system second semester</td>
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## Progress on Danielle’s Lift System

<table>
<thead>
<tr>
<th>Current Work</th>
<th>Future Work</th>
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<tbody>
<tr>
<td>• Ordering motorized jacks, power packs, battery</td>
<td>• Assemble threshold ramp</td>
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<tr>
<td>• Gather necessary raw materials from Machine Shop</td>
<td>• Machine platform, ramp component, and base assembly</td>
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<tr>
<td>• Begin preparation for assembly of the threshold ramp</td>
<td>• Fit jacks and power pack into base assembly</td>
</tr>
<tr>
<td>• Collect necessary hinges and latches</td>
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</table>
Acknowledgements

- Dr. Enderle: Design advice and guidance
- Marek: Design advice and guidance
- Ms. Baker: Provided design ideas to benefit Julia
- Giroux Family: Provided design ideas to benefit Danielle
- NEAT Marketplace- Don: Assistance in finding parts
- Matt at Pediaflex: Danielle’s Physical Therapist
- Lou Mattesen of ATG Rehab: Provided information about Julia’s existing wheelchair
- Pete and Serge: Provided advice and materials
Questions?