Final Presentation

Accessible Laptop Tray for Julia Hall
One-Armed Drive Manual Wheelchair for Danielle Giroux
Automatic Lift System for Danielle Giroux

TEAM 5
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BME 4910
Overview

• Client Information
• Client’s Needs/Purpose
• Design
  ○ Accessible Laptop Tray for Julia Hall
  ○ One-Armed Drive Manual Wheelchair for Danielle Giroux
  ○ Automatic Lift System for Danielle Giroux
• Budget
• Acknowledgments
Julia Hall

- 12 year old student at Mansfield Middle School with Cerebral Palsy
- Performs many tasks independently at school
- Uses her power wheelchair at school, but not at home
- Uses her laptop to type out her responses in her classes
Danielle Giroux

- 12 year old female with Cerebral Palsy
- Lives in Tolland, CT with parents and siblings
- No motor control or use of her left hand
- Recently underwent back surgery to improve her posture while using electric and manual wheelchairs
- Creating a One-Armed Drive Manual Wheelchair and Automatic Lift System to assist Danielle
Cerebral Palsy

- Caused by damage to motor control centers of the brain during pregnancy, childbirth, and up to three years of age.
- Limits movements and posture, accompanied by disturbances of sensation, depth perception, and communication.
- Characterized by abnormal muscle tone, reflexes, or motor development.
Laptop Tray for Julia
Purpose – Julia’s Laptop Tray

- Julia currently uses a wheelchair tray that slides on and off her chair. She needs assistance to install and remove the tray.
- She also needs a more efficient way to transport her laptop.
- Therefore, Julia’s teacher asked us to make an electronic tray that will attach to the side of Julia’s wheelchair that is easy to operate so Julia can use it at the push of a button.
- The tray should also securely hold a laptop in all tray positions.
Project Requirements – Julia’s Laptop Tray

- Tray must attach to right side of wheelchair. (Her joystick is on the left.)
- Tray must be easy to operate, so our client can use it independently.
- Tray must secure and protect a laptop.
- Must provide support for Julia, posture wise.
- The laptop must be easily detachable to charge overnight.
- The entire system should be removable, if needed.
- The device must be safe to operate in a middle school environment.
Julia’s Tray

- Made of clear polycarbonate about ¼” thick
Why use a stepper motor?
- Its position can be accurately controlled since its rotation is divided into a large number of steps.
  - Our motor divides its 360 degree rotation into 200 steps for 1.8 degree rotation per step.
- Stepper motors also fail in a fixed position

In our design:
- We used a bipolar stepper motor with 1200oz-in of torque.
- A 5:1 gearbox was attached to this to multiply the motor’s torque by 5.
Tray Movement

- Tray will swing from the side of the chair out 270 degrees to desk position.
- When hanging down, the laptop will be protected on the inside of the tray (toward the wheelchair).
Tray Attachment

Clamping System

Motor Bracket

[Images of the tray attachment system and its components]
Controlling Julia’s Laptop Tray
Controlling Julia’s Laptop Tray

- **The coding: Arduino Board**
  - Code moves the tray up or down with the push of a switch.
  - The movement is limited to 270 degrees (150 steps).
  - If the switch is released the tray will stop moving.
  - A button mounted on the chair limits movement in the up position, acts as an added safety precaution and as a code reset point.
One Arm Drive Wheelchair for Danielle
Purpose – One Arm Drive for Danielle

- Client does not have motor control in her left hand
- Difficult to propel and maneuver a manual wheelchair
- Client uses a motorized wheelchair to move around her school
- Heaviness and bulkiness make it difficult for use at home
- Client would like to use a manual wheelchair within the house or in other informal settings
- Lighter weight and less bulky
- Final product should allow the client to control a manual wheelchair with simply one 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
- 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 and easy braking system
Design – One Arm Drive for Danielle

- Invacare Cylindrical Lever Drive (CLD) System
- 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
Design – One Arm Drive for Danielle

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

- Head rest, seat pad, and foot rest all purchased at NEAT marketplace
- Contact client’s physical therapist (Matt) to discuss proper seating position
- Team was able to make custom seating pad knowing dimensions of client’s body
- Added foam in certain areas
- Custom headrest bracket that allows vertical adjustment
Foot Rest Problem

- One arm drive system interferes with right foot rest placement
- Extended left foot rest length to reach right side
- Folds normally
- Addition of foot straps
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
- Wheel locking feature prevents movement while client gets into and out of chair
- Restraint system for use in motor vehicle
- Wheelchair capable of being used on incline
Lift System for Danielle
Purpose – Automatic Lift System for Danielle

- Currently, Danielle has no way of getting into 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 in and out of relatives homes
- Client is looking for a transportable, automatic lift system that can be used as client grows
Design – Automatic Lift System

- **Aluminum Base**
  - 30”x37”x4.5”
  - 2 x 30” motorized jacks

- **Aluminum Platform**
  - 30”x37”x1/4”

- **Foldable Aluminum Ramp**
  - 30”x37”x1/4”
  - 30”x11”x1/4”
  - 4 x Support Bars

- **Threshold Ramp**
  - Adjustable 1.5”-6”
  - Aluminum
Design – Automatic Lift System

- Two motorized jacks inside aluminum base
  - Jacks controlled by two BAL power packs
  - Power packs wired together to lift jacks simultaneously
- Client’s parent will initiate lift by connecting to external battery and pressing the switch on the side of the base in the “up” direction
Design – Automatic Lift System

- Threshold Ramp
  - Adjustable
  - Aluminum
  - < 20lbs
- Attached Straps to make it transportable
- Will be used to get client onto lift system, and into house
Safety Features – Automatic Lift System

- Edging on Fold-out Ramp
- Adhesive Treading
- Tie-Downs
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Acknowledgments

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Questions?