All-Terrain Power Chair Redesign
Project 1: Annalee Hughes

All-Terrain Wheelchair Redesign
Project 2: Nathan Lamb

Beach Wheelchair
Project 23.1: Danielle Giroux

BME 4910 Final Presentation
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Overview

- Background of clients and conditions
- Purpose of projects
- Design
- Budget
- Acknowledgements
- Questions
Client Background

- Annalee Hughes
  - 12-year-old girl
  - Has Cerebral Palsy
  - Adventurous
  - Enjoys exploring her family’s three acre property which includes a pond, barn, and blueberry bushes that she enjoys picking berries from
  - Annalee has previously tipped over one of her power chairs while exploring her yard and, due to her cerebral palsy, is unable to help herself up or right her chair when it tips over
Client Background

- Nathan Lamb
  - 12-year-old boy
  - Has myelomeningocele (form of spina bifida) which also led to hydrocephalus, has an autism spectrum disorder
  - Adventurous and playful
  - Enjoys attending family outings but does not have a power chair to move around freely
  - Nathan’s family has a large plot of land with a wooded area that they would like to expand trails through that Nathan would be able to explore
Client Background

- Danielle Giroux
  - 11-year-old girl
  - Has Cerebral palsy
  - Adventurous and social
  - Enjoys trips to the beach with her family and friends
  - Her parents currently have to rent beach wheelchairs for Danielle when they go to the beach
  - The chairs that they rent are difficult to push and do not usually fit through doorways such as those for the bathrooms at the beach
Cerebral Palsy

- Condition involving brain and nervous system functions
- Caused by injuries or abnormalities in the brain
- Symptoms vary from individual to individual
- In the cases of both Annalee and Danielle, it resulted in underdeveloped muscles in the legs and upper body
- Lack of proper stimulation by the brain and nervous system has resulted in their muscles being relatively weak
- They cannot stand up or support their own weight
Myelomeningocele

- Form of spina bifida
- Birth defect: spinal cord and backbone do not fuse properly
- Caused partial paralysis of his legs, resulting in weakness in his hips, legs, and feet
- Also led to hydrocephalus, a buildup of fluid in the brain
- Underwent surgery so that the fluid would drain into his bladder to be excreted from the body
Autism Spectrum Disorder

- Developmental disability, causes problems or difficulties in social interaction and communication
- “Spectrum disorder”
  - Group of disorders with similar symptoms and symptoms can range from mild to severe
Purpose

- Redesign the all-terrain power chair built for Annalee 2 years ago
  - Seat auto-leveling circuitry was implemented but it stopped working
- Make the chair safer for use on hilly terrain
- Allow Annalee to explore her yard more freely and independently
Purpose

- Redesign all-terrain wheelchair built for Nathan last year
  - Joystick was too flimsy and wiring was causing shorts
  - Shorts resulted in unpredictable movement
  - Four fixed wheels prevented smooth, safe turning
- Allow Nathan to move independently around his yard and at family events
Purpose

- Build a collapsible beach wheelchair for Danielle
  - Give the family their own chair so that they don’t have to rent one each time they go to the beach
- Allow Danielle and her family to more easily enjoy social activities and trips to the beach
  - The chair will allow easier access to different areas on the beach, such as through doors to the bathroom
Design (Annalee)

- Redesigned circuit and programed microcontroller to auto-level the seat on the chair using accelerometers
- An accelerometer mounted on the frame of the chair, and one on the seat of the chair are used for comparison to keep the seat as level as possible at all times
Design (Annalee)
Design (Annalee)
Design (Nathan)

- Replaced front suspension with casters
  - Casters allow the chair to turn safely and properly
Design (Nathan)

- New Joystick
  - More robust and sturdy
- Built new electronics case
  - The new case is stronger than the previous one and allows for easy access to charge and replace the battery
Design (Danielle)

- Frame from the client’s old collapsible stroller
  - The frame already collapsed, it just needed to be modified to accommodate a new seat and wheels
- Casters moved to the back for easier turning
  - Torque applied to the handlebars when turning is further from the pivot point, making the turn much easier
Design (Danielle)

- Wheels replaced with balloon wheels
  - Larger surface area on the wheel allows for easier movement across the uneven, soft sand at the beach
Design (Danielle)

- Replaced seat to better fit Danielle
  - Danielle has grown, and the chair will be used at the beach so it needed to be replaced with a larger seat that is better suited for use at the beach
Budget

- **Project 1: Annalee**
  - $300 – 2 replacement batteries
  - $84.49 – PCB

- **Project 2: Nathan**
  - $320.67 – Metal stock for modifications
  - $90 – Powder coating at Central CT Coatings

- **Project 23.1: Danielle**
  - $545.18 – Balloon wheels and parts
  - $165.32 – Seat materials
  - $90 – Powder coating at Central CT Coatings
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Questions?