Portable Car Rack Lift: Transferring Handcycle Users

Jonny L. Carlson, Evan Cleveland, Vito Kuang, Rian Simpson, Alex Wang, and Niels B. Wheelwright. Advisor: Dr. Merryweather

THE UNIVERSITY OF UTAH
Department of Mechanical Engineering

HEALTH UNIVERSITY OF UTAH
Craig H. Neilsen REHABILITATION HOSPITAL UNIVERSITY OF UTAH

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Goal

The goal of this project is to design and manufacture a portable car rack lift capable of transferring individuals with paraplegia from a wheelchair to a handcycle (and vice versa). This project was requested by the TRAILS adaptive sports program to promote independence and to reduce the risk of injury to those assisting in a manual transfer.

User and Design Research

The team focused on interviewing and working alongside potential users to determine the requirements for the lift system. The team preformed wheelchair to handcycle transfers on group members to understand the challenges. From user interviews, group members experiences, and research about safety regulations, a table of specifications was developed (Table 1).

The Problem

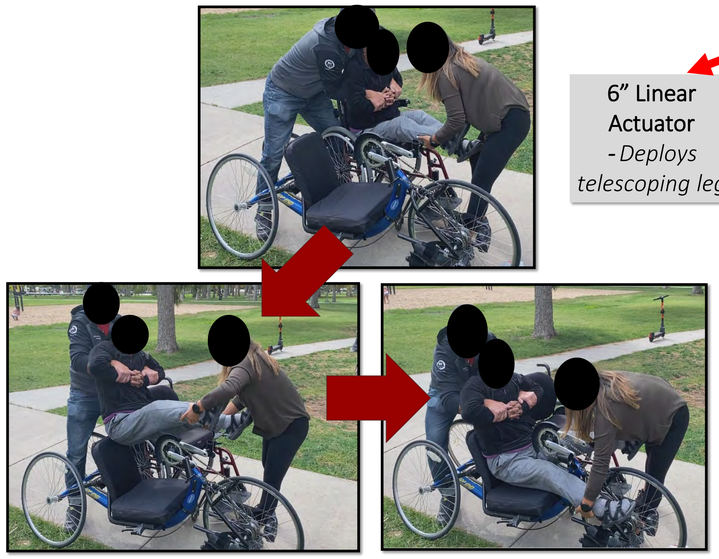


Figure 1: A manual transfer from wheelchair to handcycle

The transfer from a handcycle to wheelchair requires the assistant(s) to lift with their back bent and twisted, especially when lowering into the handcycle. This has the potential to cause injury. Additionally, some users require up to 5 assistants to transfer them to and from a handcycle.

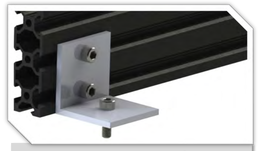
Table 1: Project specifications developed through user interviews

Relevant Specification	Desired Value	Achieved
Lift System Capability (lbs.)	>= 300	325
Deployment Time (sec)	<= 240.0	42.0
Support Leg Telescoping (in)	50 < x < 78	49 < x 80.5
Side Car Overhang (in)	< 4	0
Lift Range (in)	0 < x < 40	0 < x < 70
Max speed (in/s)	<= 2	0.69
Maximum current draw (Amps)	< 10	5
Support Leg Range of Motion (°)	0 < x < 90	0 < x < 90
Joystick Force (lbf.)	< 1	0.735

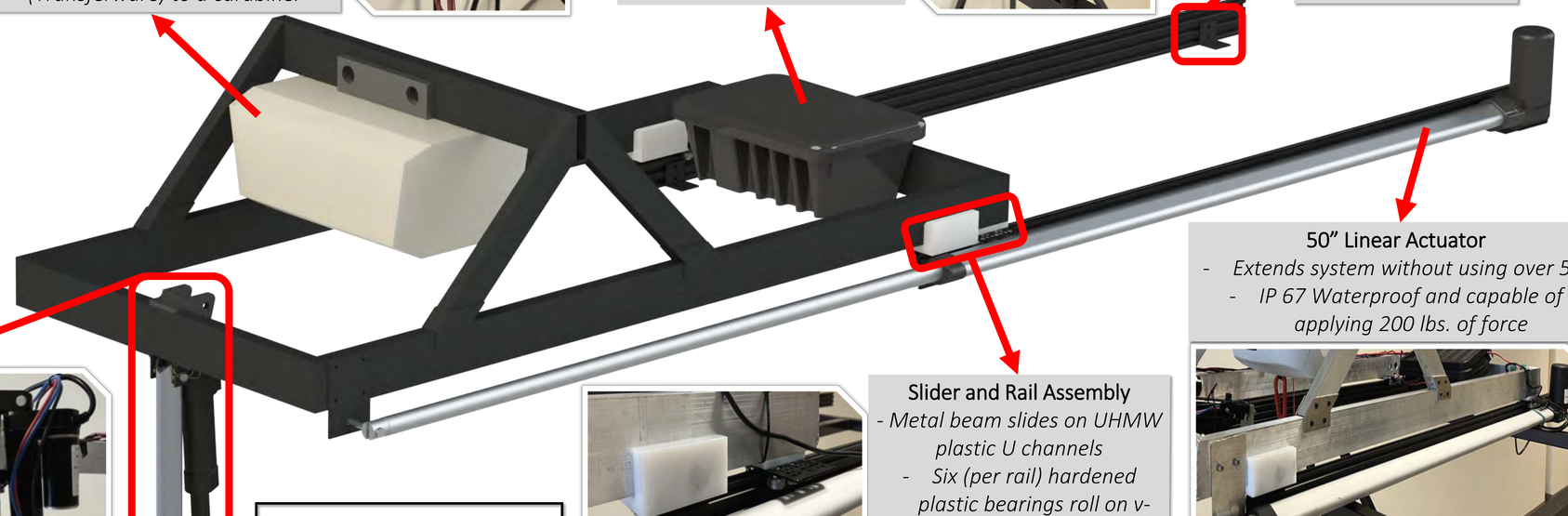
The Solution: Deployable Car Mounted Lifting System

Arjo Maxi Sky Hospital Grade Patient Lift
- Lifts users from wheelchairs and handcycles
- Users hook their harness (Transferware) to a carabiner

Waterproof Electronics Box
- Houses motor controllers, Arduino, and other electronics
- IP 55 and UV resistant
- Includes wireless receiver



Mounting Brackets
- Attaches system to A.R.E. brand roof rails



6" Linear Actuator
- Deploys telescoping leg

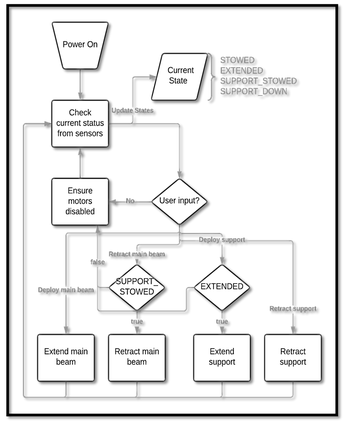


Figure 2: State Diagram

Bicycle Seatpost Clamp
- Locks leg length

Slider and Rail Assembly
- Metal beam slides on UHMW plastic U channels
- Six (per rail) hardened plastic bearings roll on v-slot rail

50" Linear Actuator
- Extends system without using over 5 A
- IP 67 Waterproof and capable of applying 200 lbs. of force

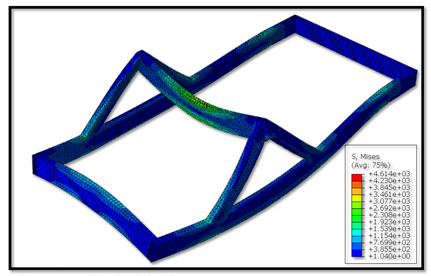


Figure 3: FEA Simulations helped design the frame to be strong enough to hold a person

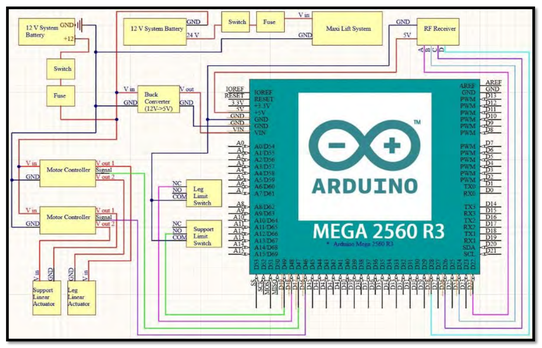


Figure 5: Wiring Diagram

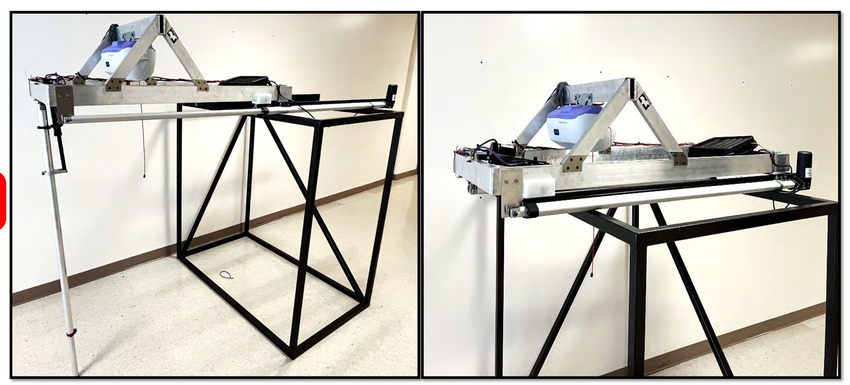


Figure 4: The current prototype deployed (left) and undeployed (right)

Moving Forward

The team successfully designed, manufactured, and tested a fully functional system prototype. The next step of the project involves handing off the project to the TRAILS group for additional user testing, system evaluation, and further development. This includes waterproofing the patient lift and modifying the control system to allow for wireless joystick. Additionally, existing safety systems need to be further refined to be more user friendly.

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