SECONDARY AIRLINE MOBILITY DEVICE

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ABSTRACT

Airline travel is currently very challenging for individuals in wheelchairs. Due to airplane aisle width and security restrictions, multiple chair transfers are required to move a traveler from their main wheelchair to their seat. When these transfers take place, disabled individuals risk being injured or embarrassed during the process. Current designs that work to eliminate or ease transfers are scarce and expensive. Our client, Dan Dorszynski, has tasked us with creating a design for a secondary mobility device to reduce the number of transfers required to board and exit a plane. The team has created a secondary device that fits over wheelchairs and has folding legs. It is manufactured from aluminum extrusions with a padded seat and backrest, as well as instructions for the airline attendants. Testing has proved that the design can hold 305 pounds statically and can hold at least 200 pounds while moving. This design has the potential to improve travel conditions for disabled persons and the airline workers who aid them.

CURRENT AIRLINE TRAVEL ISSUES

Passengers traveling with wheelchairs historically face many problems when travelling by airplane:

- 32,445 Disability-Related Concerns filed in 2016 [1]
- 55% of disabled passengers cite problems at airports [1]
- 12,637 reported receiving no assistance with their wheelchair [2]

EXISTING DEVICES

Figure 1. (left to right) A standard aisle chair, a folding aisle chair, and a convertible aisle chair.[3]

MOTIVATION

To improve the overall quality of air travel for disabled persons by:

- Improving the ease of transfers for airline employees
- Eliminating half of the transfers for wheelchairs and aisle chairs
- Improving the overall safety of airline travel for disabled persons.

DESIGN CRITERIA

- Minimize the number of transfers
- Fit down the aisles of passenger planes based on FAA regulations
- Ideally cost less than $500
- Storable on the plane
- Strong enough to support 300 pounds
- Easy for airline attendants to use

FINAL DESIGN

Figure 2. Rear view of completed prototype

Figure 3. Front view of completed prototype on client's wheelchair

Features:

- Fits over client's current wheelchair
- Rear wheels fold underneath into frame
- User-friendly locking mechanism for rear wheels
- Handles on back of chair for ease of use
- Total prototype cost - $470

Impact:

- A rear wheel folding design eliminates two transfers per flight, and eliminates half of the total transfers in a round trip flight
- Eliminating transfers reduces embarrassment and chance of injury
- Increasing safety encourages more wheelchair users to fly

Figure 4: Close-up of rear locking mechanism

TESTING PROCEDURES

Test of Locking Mechanism: Evaluating locking mechanism with a 200 pound load, moving in reverse.

Figure 5: Initial failure of locking mechanism

Static Load Test: Load seat with 305 pounds without movement

Figure 6: Static load test with chair holding 305 lbs

Front Leg Load Test: 155 pound impulse was placed on the front legs to simulate a bump

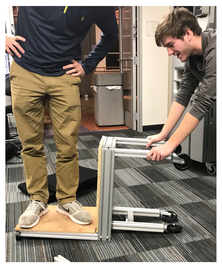

Figure 7: An impulse load is applied to simulate running into a bump.

Mobile Load Test: Load seat with 200 pounds, moving forwards and backwards at 2.3 MPH

Figure 8: An example of a load being applied while moving.

RESULTS

- The chair statically held 305 lbs
- The front wheels bore an impulse force from a 155 lb teammate's body weight
- Chair successfully transferred a team member onto and off of a wheelchair with the legs effectively folding in and out
- Chair back legs withstood heavy kicks with a passenger on it
- Chair moved forward and backward at 2.3 mph under a 200 pound load

Figure 9: A failed joint resulted in a design change during testing

- Two failures during testing led to design changes:
  - The bolt locking mechanism bent initially.
  - Multiple fasteners fractured during a mobile load test.

FUTURE WORK

- Decrease weight
- Safety features - seat belt
- Stowability/collapsibility
- Simpler locking mechanism with less steps
- Comfort - arm/footrests
- Increase marketability
  - Current device designed specifically to client
  - Address needs of all disabled passengers
- Work with airline workers and other disabled persons

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