Portable Recliner

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Abstract

Our client, due to several physiological ailments, encounters difficulty with sitting up from a reclined position or standing from a seated position. However, he can still walk with a walker for short periods of time and finds himself well enough to travel. This is not uncommon, and could also be the case for individuals with MS, cerebral palsy, and stroke victims. In order to meet the client's needs, our team aimed to create a reclining chair that is portable enough to take on overnight trips away from home and can assist the client in sitting and standing. Our prototype uses a wood frame and a lift seat, as well as a torsional spring back support to achieve this assistance. Future work will implement this design in a more portable fashion.

Motivation

There are many mechanized recliner systems or chair-sleeper converters currently available in market. However, they are all very large (>36" tall and >34" wide) and non-collapsible. Additionally, these products are all very heavy, weighing upwards of 135 lbs. Examples of these types of products can be seen in figures 1 and 2. All truly portable (<40lbs) lift system products use inflation as a lifting mechanism and are not designed for long term use. An example of this can be seen in figure 3.

Figure 1: Power recliner (1)

Figure 2: Convertible sleep chair (2)

Figure 3: Inflatable emergency lift system (3)

There are several diseases, including multiple sclerosis (4), muscular dystrophy (5), and stroke (6) that cause loss of muscle function but leave the patient well enough to travel with the right equipment. This product could be well adapted for use by individuals with these conditions.

Design Criteria

- Able to sustain a load of 140 kg for up to 16 hours.
- Comfortably fit a person up to 175 cm tall sitting or laying.
- Collapsible; should be able to fit in the trunk of a car (< 0.368 cubic meters).
- Must be able to be carried and assembled by 1 individual (< 18 kg).
- Able to recline and should contain a footrest that elevates.
- Able to assist a person in sitting or standing.
- Budget is $200.
- Dimensions should be 44.5 cm high at the seat, 180 cm long, and 50 cm wide.

Final Design

- **The final design consists of the following elements and can be seen in figure 4**:
- Box-shaped seat area (a) supported by 4 removable legs. These legs can be unscrewed for transportation.
- UpEasy pneumatic seat lift places in seat assists in lifting user from a seated position to a standing position (see Figure 5).
- Seat back (b) connected to seat with hinges. This can be folded on top of the seat for transportation.
- Seat back rests on removable support (c) in prone position. This removable support fits into pre-cut notch in seat box and has two legs.
- Torsional spring connected to seat back and seat frame assists in lifting user from a reclined position to a seated position.
- Footrest (d) also connected to seat with hinges. This can be folded down or removed for transportation.
- Footrest has swing-out leg support.
- Cushions to provide the comfort level needed to sleep.
- Armrests with foam cushion provides added comfort. They also can be removed for transportation.

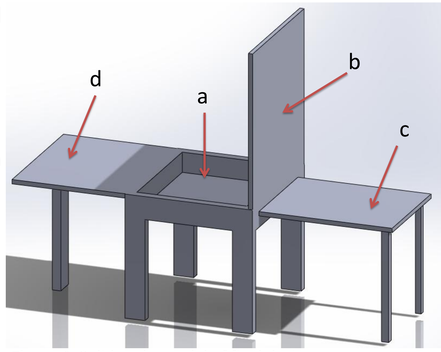


Figure 4: Solidworks model of final design

Figure 5: UpEasy pneumatic lifting seat (7)

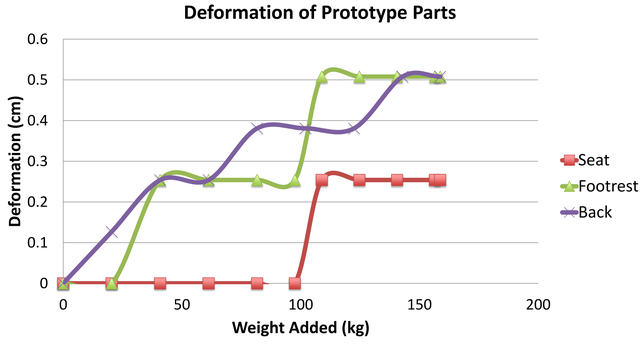
Prototype Fabrication

- Legs and seat frame constructed out of pine 2"x4"s.
- Seat support, backrest, and footrest constructed out of plywood sheets.
- Double headed screws (hanger bolts) allow for removability of legs.
- Fabric covered high density foam secured in place with staples increases comfort.

Testing and Results

Testing Procedure

- Stepwise loading tested on various components of the final prototype: seat, footrest, and backrest.
- Each piece was loaded in increasing increments, measured for deformation, and analyzed for signs of failure.
- Each test was conducted twice. The average results are shown.



Results

- Each of the completed chair components was tested with 159 kg (350 lbs.) load and 0.25 to 1 cm of deformation was seen. Additionally, there was no cracking or visible signs of failure.
- No deformation remained on any part after the load was removed.
- An example of testing can be seen in figure 7.
- The legs of the seat were also tested individually. These were able to support 68 kg (150 lbs.) of load both in axial compression and from a lateral load.

Figure 6 (above): Deformation vs. load added for parts
Figure 7 (left): Test for back strength of prototype

Budget

Item	Cost
UpEasy Lift Seat	$99.00
Pine 2"x4"s and plywood sheets	Donated
Hinges	$18.95
Screws, nails, and misc. hardware	$19.59
Fabric	$14.21
Cushion high density foam	$42.19
Paint	$25.26
Total Cost	$219.20

Future Work

- For greater portability: rebuild the prototype out of metal.
- Also for greater portability: create a carrying case for the chair parts and create removable cushions.
- Conduct more rigorous testing on parts and total chair including long-term stability testing and repeated wear.
- For the base: alter the dimensions and hinge types so both the back and footrest fold over the seat for increased portability.
- For the footrest: add a torsional spring for assistance with raising the footrest and incorporate locking mechanism for greater ease of use.
- For the back: add a torsional spring and pneumatic lift system for greater assistance with raising and lowering the back. Also, incorporate a locking mechanism for the torsional spring for greater ease of use.

References

Acknowledgements

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