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Abstract

Many spinal cord injury (SCI) patients are confined to using a wheelchair for mobility. Propelling wheelchairs manually is a difficult task in rainy circumstances due to several factors. A protective, retractable canopy was proposed to attach to manual wheelchairs in order to provide protection from the rain and allow users to propel their chair during rain.

Introduction

Spinal cord injury (SCI) occurs as a result of damage to the spinal cord region. Patients are generally left with limited mobility depending on the region of the spine injured and may require the use of a mobility assistive device. Up to 31% of SCI patients may require the use of a manual wheelchair [1-4]. Due to a regular umbrella being unsuitable for these patients, users are forced to wait out the rain or travel in the rain. In the case of the former, quality of life is reduced. In the latter, moisture buildup combined with friction from sitting for an extended period could contribute to the development of comorbidities that SCI patients are already at increased risk for such as pressure sores.

Design Specifications

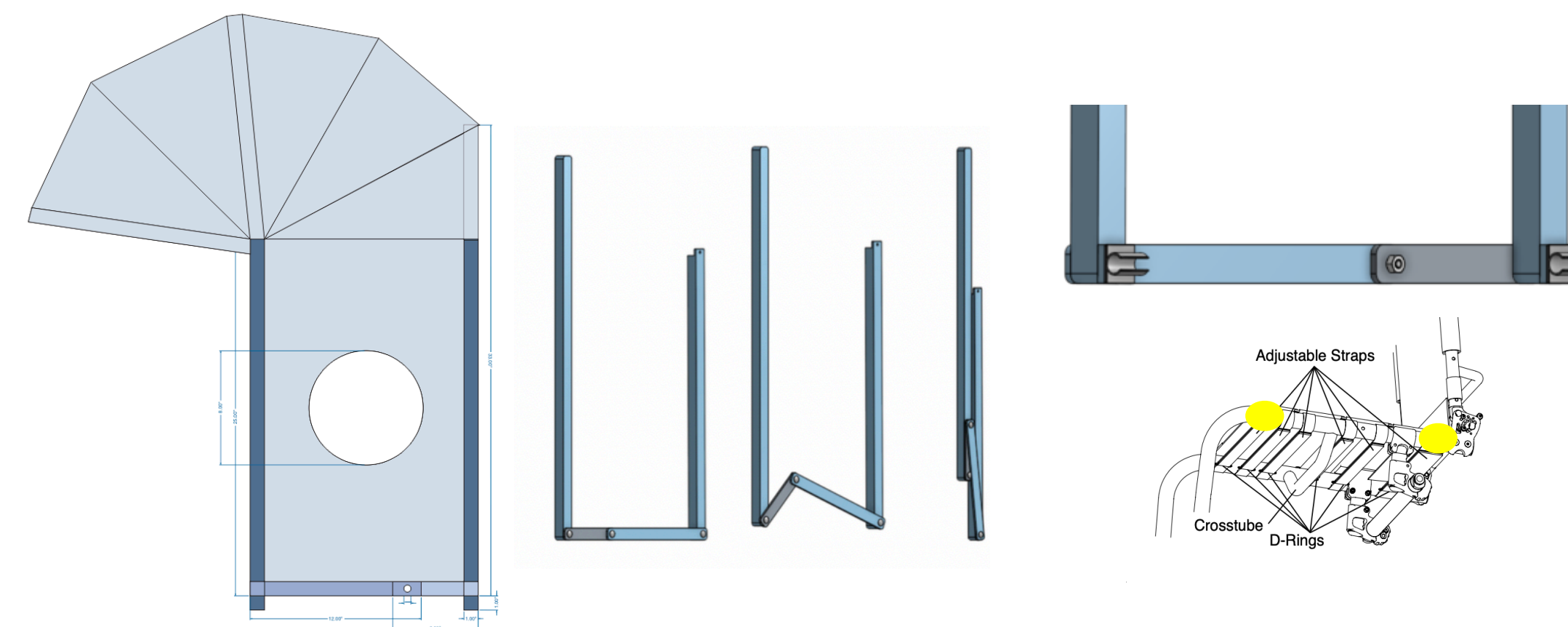
Design specifications were created considering comments from participants at the Miami Project; foremost that the design be portable, easily assembled at a moment's notice, lightweight and not impair their ability to propel the chair.

Design Parameters	Acceptable	Desired
Structural Integrity	Device does not fall apart when used for up to 10 minutes in rain.	Device does not fall apart when used for up to 1 hour in rain.
User Protection	Shields rain from head and trunk.	Shields rain from head, trunk and limbs.
Weight	No more than five pounds.	No more than two pounds.
Effect on Center of Gravity	Little effect.	No effect.
Folding Dimensions	5ft x 3ft x 0.5ft.	3ft x 1t x 0.5ft.
Assembly Time	Less than five minutes.	Less than two minutes.
Operating Environment	Used in temperatures from 60F-80F and wind up to 10 mph.	Used in temperatures from 50F-90F and wind up to 20 mph.

Methods | Design | Analysis

Retractable canopy design was developed by integrating and modifying a pre-existing canopy on an extended, hinging frame to provide the ability to fold into a smaller size.

- Paddle clips connect the product to the wheelchair seat frame.
- Opening in the side of the fabric with protruding plastic sleeves provide ability to use arms to move wheelchair.



Results

Results were simulated for several tests including user protection and assembly time.

User Protection

Rain Type	Total % Wet in Competitor	Average Total % Wet with Device	% Change in Wetness Due to Device Use
Light	77	6.6	70.4
Moderate	90	7.2	82.8

Assembly Time

Average Assembly Time Without Prior Knowledge (s)	Average Disassembly Time Without Prior Knowledge (s)	Average Assembly Time With Prior Knowledge (s)	Average Disassembly Time With Prior Knowledge (s)
204.24	174.76	158.64	140.3

Conclusion

There is a large gap in the market for a device in this need area, and the quality of life of manual wheelchair users could be significantly improved. Physical construction and testing were not able to be completed, but the device is expected to function successfully.

Acknowledgments

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