



Centralized Wheelchair Visibility System

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Project Need

Wheelchair users often must use the road instead of the sidewalk due to poorly maintained or non-existent safe pedestrian infrastructure (Nemire, 2010).

Project Objective

Create a lighting system for wheelchairs to better illuminate them. The device includes lights for both the front and back of the wheelchair which are controlled with their accessible buttons (Webber, 2019).

Prototypes

Design Version 1

The first design included a large acrylic box with openings for the lights. We decided the lights were too big.



Figure 1: Design Version 1

Design Version 2

The second version design included a smaller acrylic box and boxes for the armrests. We decided we n

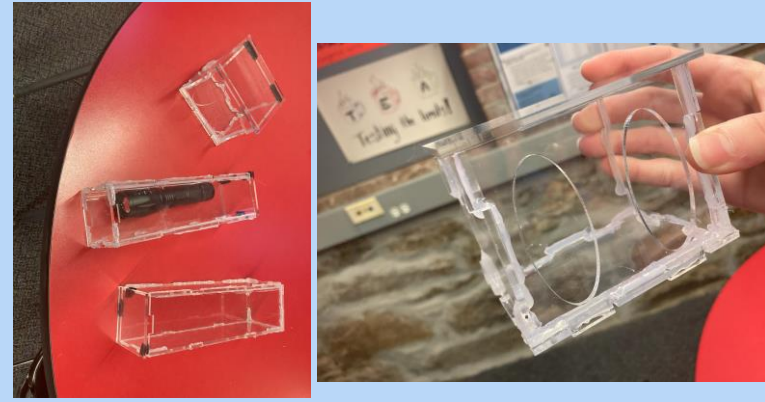


Figure 2: Design Version 2

Design Version 3

The third design version was made waterproof with sealed openings and included spaces for hinges.



Figure 3: Design Version 3

Final Version 4

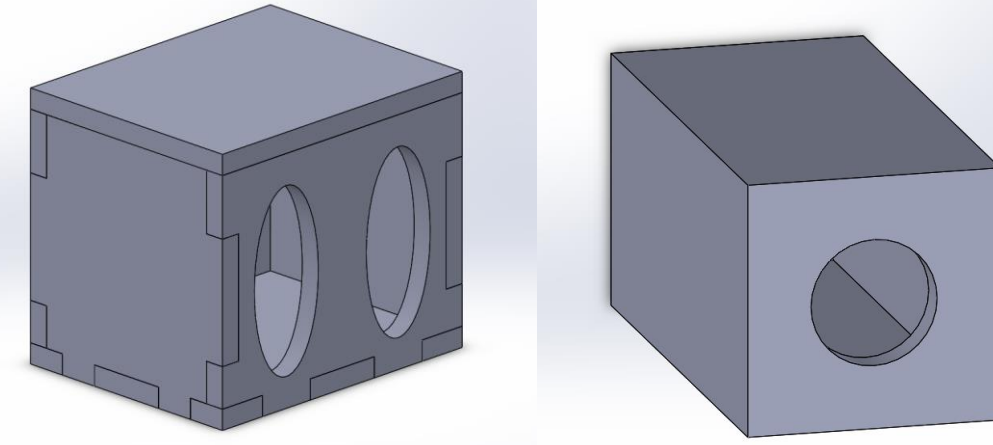


Figure 4: Components of Centralized Light System in C.A.D.

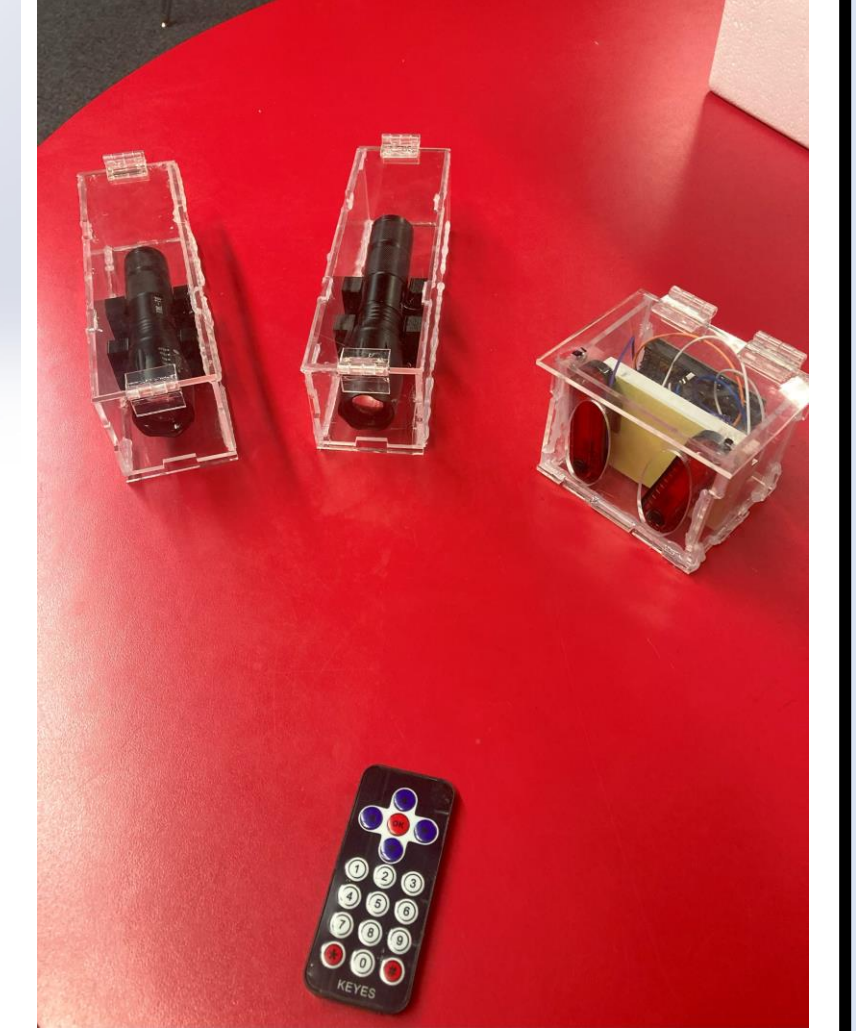


Figure 5: Acrylic Printed Back Wheelchair Light with Red LEDs and Remote & Acrylic Printed Front Wheelchair Lights with White Light Flashlight; Includes Hinges

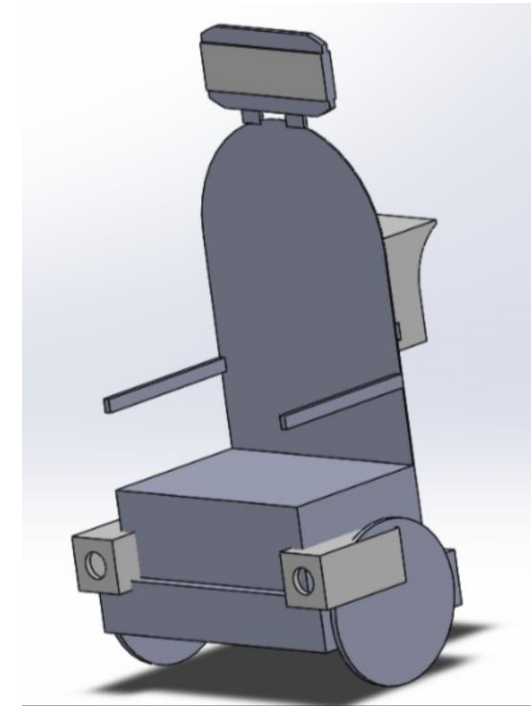


Figure 6: General Schematic Wheelchair of Light System in C.A.D.

Features

- 3 Light Systems for the back of the wheelchair and the front
- Variety of LED colors
- Accessible on and off mechanisms
- Waterproof

Requirements

	Wheelchair Led Sign Competitor	Tetragear Wheel Light Competitor	Wheelchair Flag Competitor	Our Design
The design should be producible for \$125 or under.	Yes	No	Yes	Yes
The design should be waterproof and able to function in rainy/wet conditions.	No	Yes	Yes	Yes
The device should provide lighting to increase the visibility of the wheelchair user to drivers.	Yes	Yes	No	Yes
The design provides lighting in front of the wheelchair user to better see where they are going (ex. headlights).	No	No	No	Yes
The design should be durable enough to survive daily use and should be solidly adhered to the wheelchair so as not to break.	No	Yes	Yes	Yes
The design should be easy to maintain, including ease to recharge the battery or change out broken parts.	No	Yes	Yes	Yes

Figure 7: Competitor Analysis and Engineering Matrix

Methods

For Assembling the Back Red LED Box:

Begin by attaching the side with the Velcro backing to the back of the wheelchair. Then, turn the lights on using their buttons or use the remote to control the lights. For battery replacements, use the top hatch to open the box and charge with the USB port.

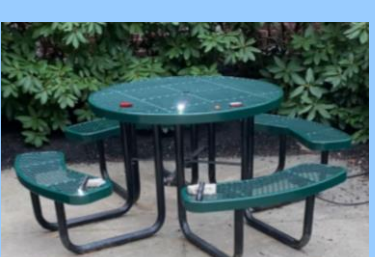
For Assembling the Front LED Flashlight Box:

Begin by attaching the side with the Velcro backing to the bottom of the wheelchair armrest on each side. Use the hatch to open the side and turn the flashlight on with the button. To replace the battery, open the hatch and easily access the battery opening area.

Design Studies

Study 1: Effectiveness of Lighting for Visibility

6 student drivers at MAMS were asked, on a scale of one to ten, to state how visible they believe the current device to be.



Study 2: Durability of the Protective Boxes

To make sure these boxes are durable and effective protection against the light system, they were dropped from various heights, using measurements from the wheelchair and factoring in normal accidents and accidental drops.

Study 3: Waterproof Abilities

The prototype was tested in simulated rain to see if any water could get in.

Study 4: Ease of Use

The prototype was tested to gain insight into how easy the device would be to use for the client.

Conclusion

With support from proof-of-concept testing with simulated infrastructure and light conditions, this light system will increase the visibility of a wheelchair user while on the road during the day or night. Future work includes additional remote connections, more client testing, and exploring different designs for different wheelchairs.

References

- Nemire, K. (2010). Case Study: Wheelchair Conspicuity at Night. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, 54(10), 743-747. <https://doi.org/10.1177/154193121005401004>
- Webber, J., Wuschke, J., Sawatzky, B., & Mortenson, W. B. (2019). Evaluating common approaches to improve visibility of wheelchair users. *Assistive Technology*, 1-5. <https://doi.org/10.1080/10400435.2019.1608478>