Project See

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Company Sponsor:
Greg Carpenter

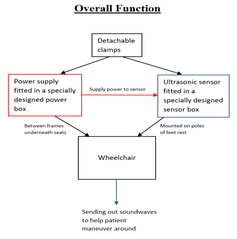
Design Duration:
14 weeks

Objective:
Design a mounting system on a wheelchair that would accommodate the sensors, computer, and power source for a visually impaired patient.

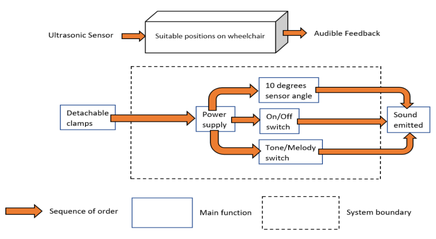
Background:
The Cerebral Palsy Research Foundation (CPRF) is an organization that provides services to people with Cerebral Palsy and other disabilities. One of the current client is a young girl who is legally blind and has a physical impairment which makes it difficult to walk without assistance. Therefore, CPRF has provided her with a wheelchair but seeks to create a mounting system that would be attached to her wheelchair and provide her with audible feedback.

Problem Statement:
In order to design a functional mounting system, the mount had to meet some requirements:

- Cost Effective: Overall mount must cost around $100.
- Durable: The mount must be able to withstand weather and rough impacts.
- Repeatable: The mount should ideally be repeatable for other wheelchairs and patients.

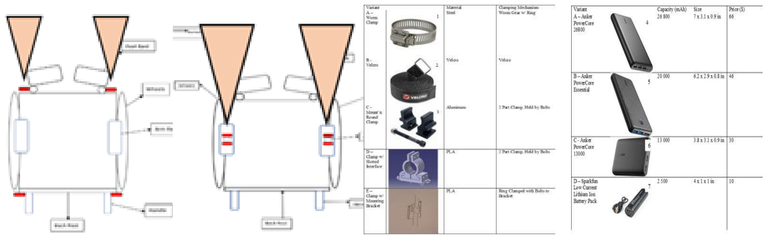


Overall Function Structure

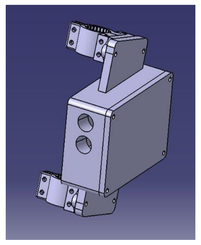


Function Structure Block Diagram

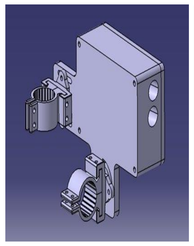
Design Variants:
In the early stages of the design process, the group compared different clamping and mount solutions. It was ultimate decided to mount the sensor boxes to the footrests to allow for maximum sensor range and comfort. The team also created a selection for the clamps and power banks, which variant A and D was chosen, respectively.



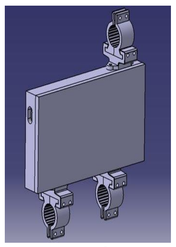
Detailed Design:
In order to the deliver power to the sensor(s), a solitary power station is placed below the wheelchair. This power supply is then connected to two individual sensor boxes that each contain identical components. All of them are connected by 3-D printed clamps.



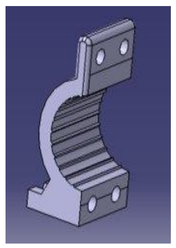
Front sensor box



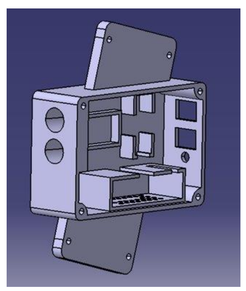
Rear sensor box



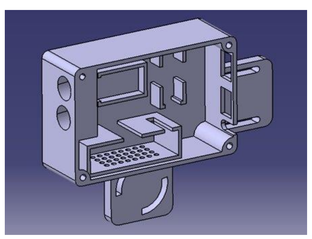
Power box



Clamp

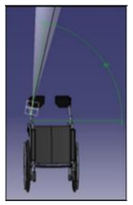


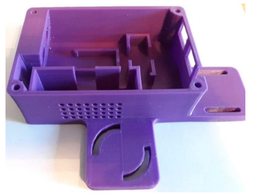
Inside of front sensor box



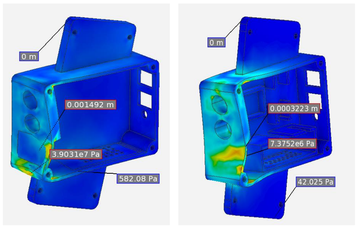
Inside of rear sensor box

Final Design:
It was ultimately decided to use ¼” thick grips and small teeth for clamping uses. An angle of 80 degrees relative to the user was selected for the mount angle.





Kinematic and Stress Analysis:
Pictured below is a FEA model of the front sensor box. Under extraordinary forces, the box experienced no critical failure in any area. Only the front sensor box of the sensor system is subject to static methods of failure, as other sensors are protected beneath the wheelchair. Because 3D Printed ABS material is difficult to model within standard programs, two FEA models were used. The FEA model on the left displays a hollow model, while the model on the right displays a fully solid model. It is logically expected that the real-world results would ultimately be between these two extreme cases.



Conclusion:
The developed mounting system conforms to all aforementioned design requirements. Furthermore, the end product provides an ergonomic and natural experience to the end user.

A special thanks to Greg Carpenter for his continued guidance in creating an ergonomic design and helping supply parts such as the Arduino board, speaker system, and sensor switches.