A Novel Camera Mount for Wheelchair Users

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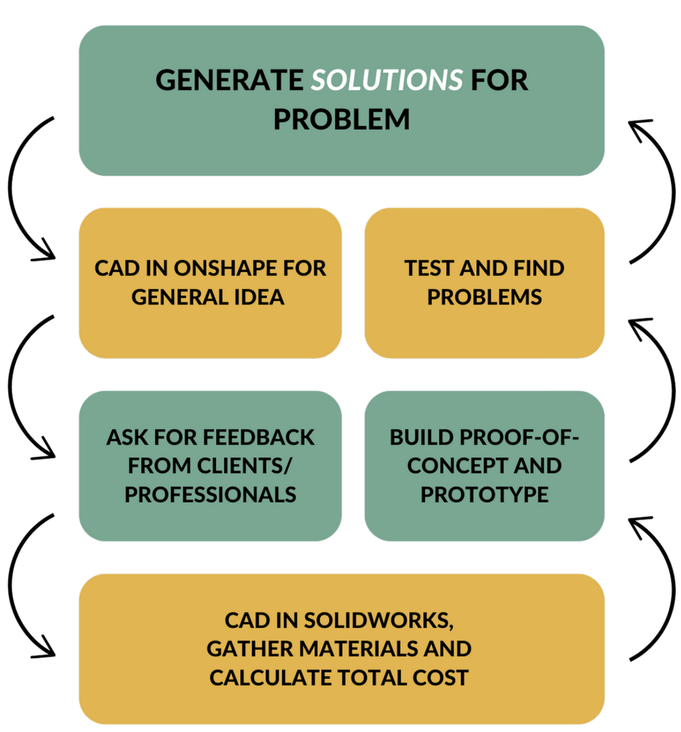
Problem Statement

Existing camera mounts for wheelchair users limit **independent** and **comfortable** pursuit of photography and videography due to **cost**, **rigidity**, and **limited range-of-motion**.

Engineering Goal

The goal is to create an **app-controlled** camera mount for **different wheelchair models** enabling independent photography and videography from a **variety of positions** at a low cost.

Methodology

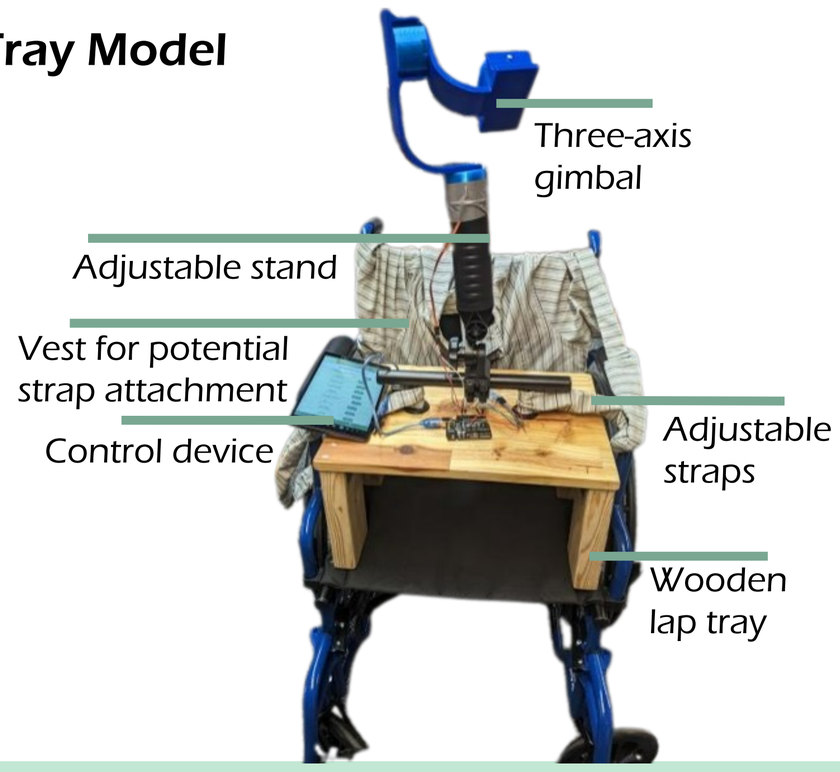


Our Current Design

The Lap-Tray Model

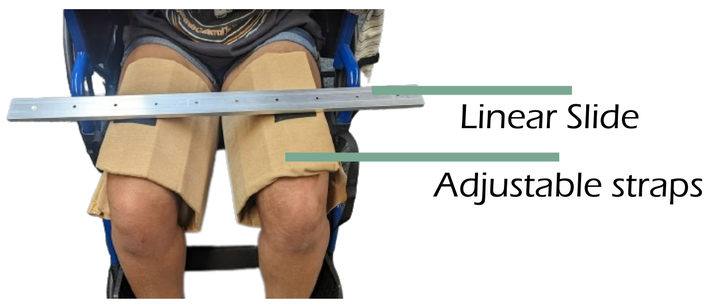
Why We Chose This Design:

- **Easy** to attach/remove
- **Universal** to all wheelchairs
- Highly **adjustable**
- **App**-controlled
- **Secured** on wheelchair
- **Multiple** degrees of freedom
- Can **support** the weight of heavy cameras



Design II

Body Attachment System

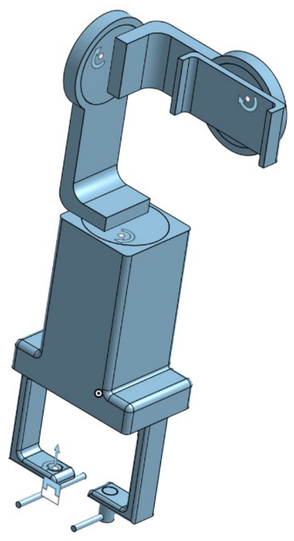


Pros
- Universal to all wheelchairs

Cons
- Restricted movement
- Unstable
- Not accessible

Design III

Rotational Selfie Stick



Pros
- Potentially app-controlled
- Some degrees of freedom

Cons
- Not universal to all wheelchairs
- Difficult to attach and remove independently

Design IV

Three-Axis Gimbal, Version I

Pros
- Potentially app-controlled
- Many degrees of freedom

Cons
- Too weak to support even light cameras
- Unstable
- Fell apart easily

Design Study I

Torque on Motors

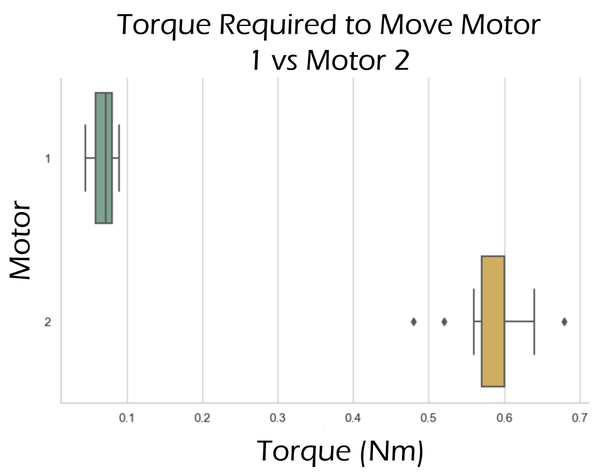
Purpose: To determine which motor would be more capable of **supporting the camera's weight**

Independent Variable: Motor type

Dependent Variable: **Torque** required to make the motor spin

Conclusion: Motor 2 is significantly stronger than Motor 1 ($p < 0.0001$)

[from a 2-sample t-test]



Design Study II

Optimal Attachment Method

Purpose: To determine which attachment method would be **most secure**, **most accessible**, and **least restrictive**

Independent Variable: Location of attachment

Dependent Variable: Device security, accessibility, freedom of movement

Conclusion: Straps should attach to the **door handle** and the **wheelchair arms**

Conclusions & Future Work

- The most challenging part was making the device **stable** and **compatible** with every wheelchair
- Interconnected parts made the device complicated
- Making the device **more stable** would be helpful when the user is on a bumpy surface
- **More degrees of freedom** would ensure flexibility

A Mobile Application to Control a Camera Mount

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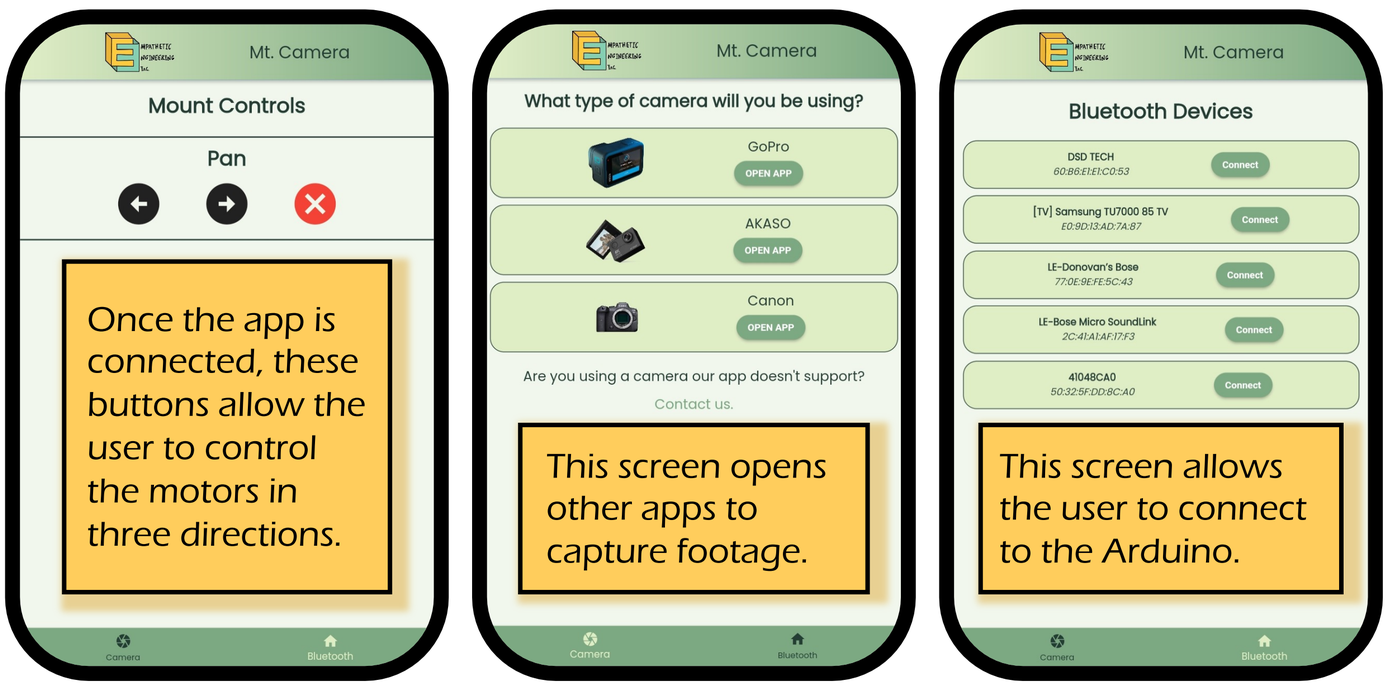
Requirements

Level	Requirement Statement	Type
1	The mount shall support the camera's weight.	Physical
1	The mount shall rotate 360 degrees.	Functional
1	The user can capture footage using an app.	User
2	The mount's weight shall not exceed 50 lbs.	Physical
2	The cost of materials shall not exceed $500.	Cost
2	The camera shall be easily detachable.	Functional
2	The mount shall move up and down.	Functional
2	The mount shall self-stabilize.	Functional
2	The mount shall have a screen to display footage.	Functional
3	A user manual shall accompany the mount.	Documentation
3	The camera shall act as a rear-view mirror.	Functional
3	The mount can support itself.	Physical
3	The mount shall have attachable wheels.	Physical
3	Replacing broken parts shall not be costly.	Cost
3	The device shall look sleek and refined.	Functional

App Development Goal

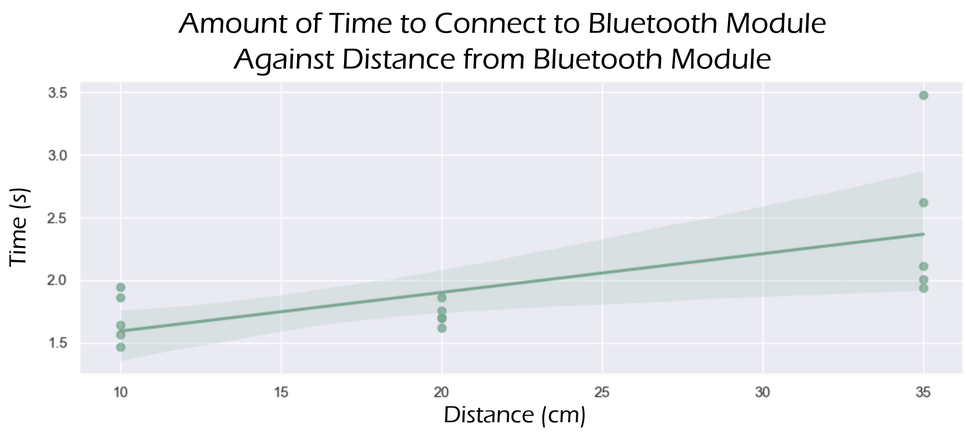
The ***goal*** is to create an ***easy-to-use***, ***accessible*** mobile application that can control a three-axis camera gimbal attached to an arm.

The App and Its Screens



Design Study III

Latency of Bluetooth Connection



Purpose: To measure the **realistic range** of connecting to the Bluetooth module of the Arduino. The gimbal ***should not be farther*** from the user's phone than this range.

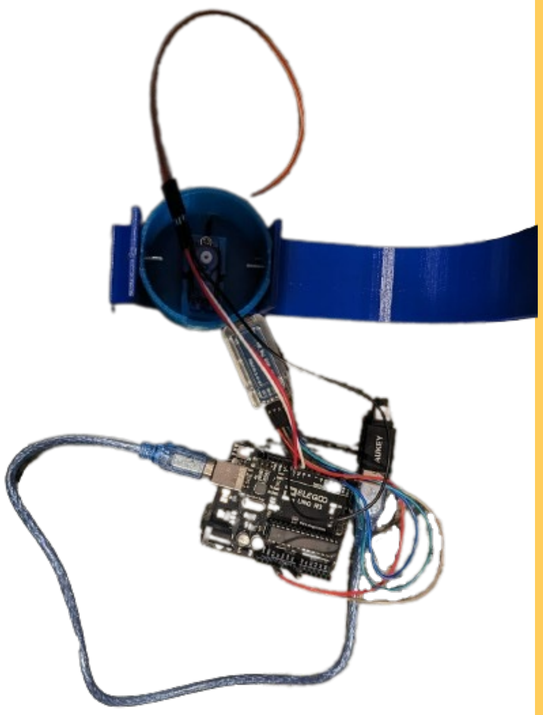
- Repeatedly **connected** to the Bluetooth module from 10 cm, 20 cm, and 35 cm away from the device
- Found that on average, the **farther** away the device, the **longer** it took to connect, although this correlation is moderately weak

Design Study IV

Range of Motor Control

Purpose: To measure the **realistic range** of controlling the motors once the app connected to the Bluetooth module. The gimbal ***should not be farther***

- Repeatedly tested the control of motors from various distances away from the gimbal
- Found that the motors could still be controlled from **35 feet away** once connected to the Bluetooth module at a close distance



Competitors

Arduino Bluetooth Controller

BLE Scanner

MIT AI2 Companion

Resources

Flutter

Android Studio

Extensions

- Connecting to cameras **directly** rather than relying on 3rd-party apps
- **Smoother connection** to the Bluetooth module

Citations

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