Personal At-Home ADA Door Opener

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The Problem

Opening doors can be a challenging endeavor for individuals with limited mobility, requiring physical strength and balance that can be difficult for those using crutches or wheelchairs.

Existing solutions exist, but are:

- Expensive
- Not suitable for home use
- Not user-friendly for DIY installations

★☆☆☆☆ **Nicely Finished Junk A NIGHTMARE OF WASTED INSTALLER TIME WITH A KICKER**
Reviewed in the United States on November 5, 2021
Color: Aluminum | **Verified Purchase**

★★☆☆☆ **Unintelligible and incomplete installation instructions**
Reviewed in the United States on July 25, 2024
Verified Purchase

★☆☆☆☆ **Installation Instructions**
Reviewed in the United States on June 24, 2024
Verified Purchase

Current Market Products

Olideauto	Door Closers	CareProdX	Anderson
			
$699	$2227	$2195	$1973

There is a need for an automated, cost-effective door opener that supports handicapped individuals, enabling easier, safer, and independent access to everyday spaces.

Solution Ideation

Durability

How many cycles do we expect & design for?

Materials

What materials should we use to meet our durability and cost goals?

Key Forces

How much friction do we need to generate and how?

Constraints

Durability

>10,000 open/close cycles on original hardware

Forces

10lb to open door
11.1lb friction force @ wheel

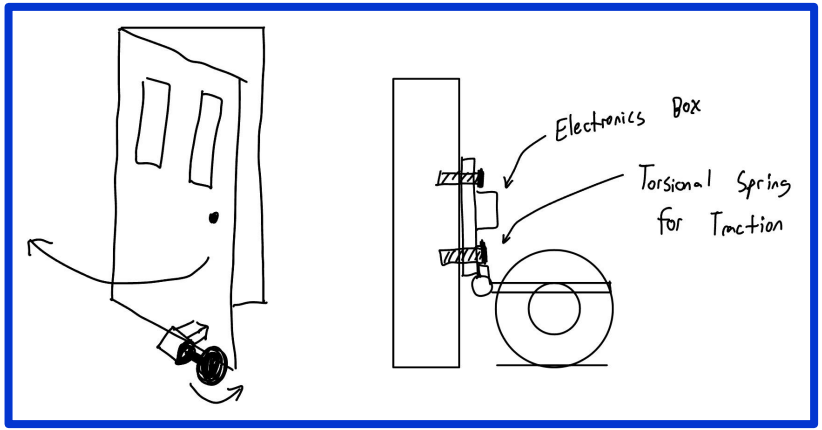
Materials

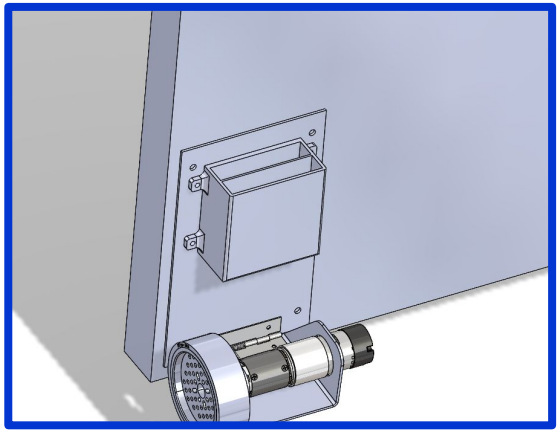
Mass produced off-the-shelf electronics for balance of cost/reliability

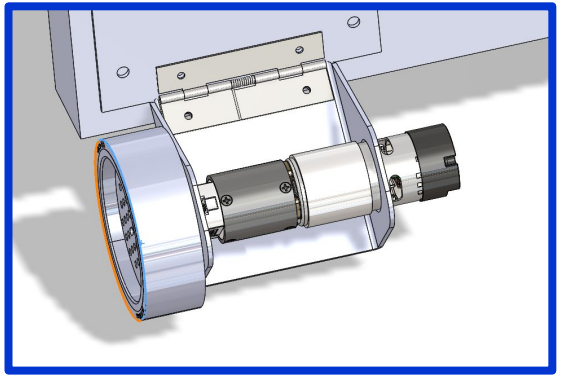
Power

110V power required

Initial Sketch & Design







Design Overview

01

Electronic Control Housing

Contains control system for motor and power distribution systems

02

Motor Assembly

Connects motor and wheel mechanically to mounting system

03

Mounting Plate

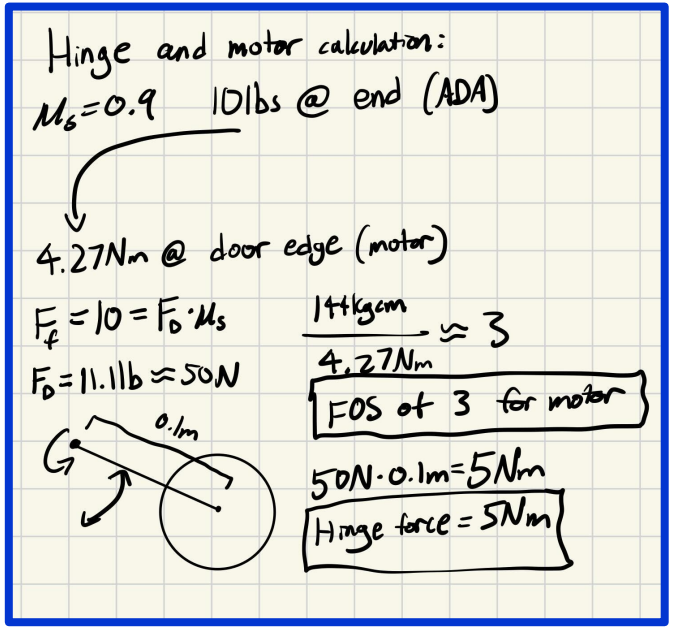
Connects all components to central plate that mounts to door

04

Hinge

Provides spring force to facilitate sufficient normal force to wheel

Hand Calculation – Motor/Hinge/Material Selection



Motor Sizing:

- Using given torque and friction values, motor torque range could be established
- Given available options, we chose the 144kgcm motor
  - FOS of 3, which covers wide range of possible door resistances at hinge

Hinge Sizing:

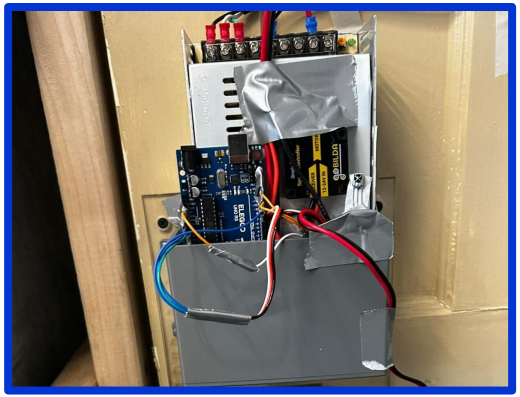
- Chose spring loaded hinge as normal force applicator
- Determined preload of spring by calculating required normal force using given friction coefficient
  - Sized for 5Nm for optimal grip

01

Electronic Control Housing

Overview:

- Contains all control and power electronics
- Consists of some key components:
  - Arduino – Remote control/motor driver signals
  - Motor Driver – Sends signal/power to motor
  - IR Sensor – Receives/transmits signals to arduino
  - Power supply – 110V input to 24V output for powering Arduino/Motor driver

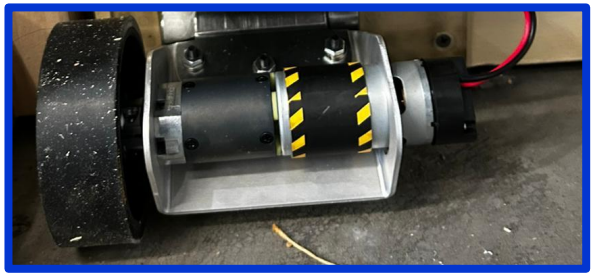


02

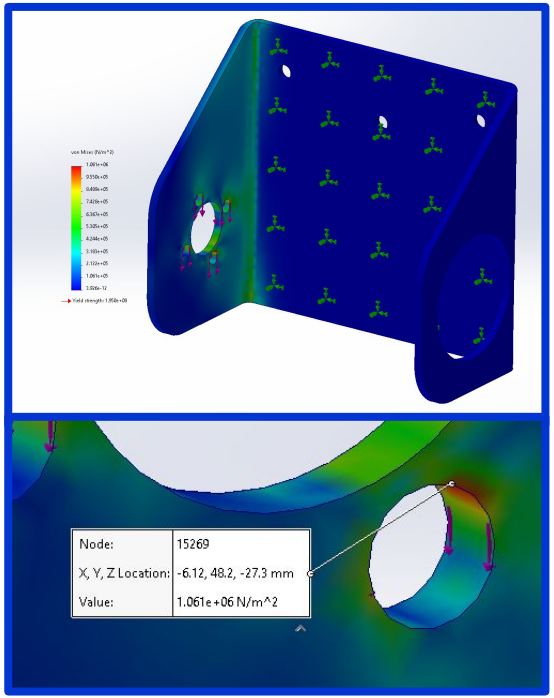
Motor Assembly

Overview:

- Motor direct drives wheel for operation
- 144kg-cm 260RPM Drive Motor
- High traction rubber wheel for various surfaces
- Wheel/motor combination selected for optimal balance between torque and speed



FEA/Optimization



Bracket Sizing:

- Used FEA to determine the minimum thickness of sheet metal while sustaining a **5 FOS** (for shock loads)
  - Used calculated loads as applied loads
  - Fixed supports at hinge for worst case
- FEA results showed that we could support all loads at 1 face, removing need for rear motor support
  - Reduced mass of part while maintaining required strength
- Landed on **2.5mm 5052-H32 Al**
  - **Great bendability & low cost**

	Yield Strength(Mpa)	Density(kg/m^3)	cost($/kg)	Cost per volume($/m^3)	Cost per strength (cost/yield strength)
6061 Aluminium Alloy	275	2700	1.80	4860	17.67
5052 Aluminum Alloy	193	2680	1.80	4824	24.99
4140 Steel Alloy	655	7850	.30	2355	1.77
polycarbonate	.97	1200	4.90	245	252.57

03

Mounting Plate

Overview:

- Laser-cut Acrylic
- Electronics box and hinge bolted to plate
- 4 screw installation to door

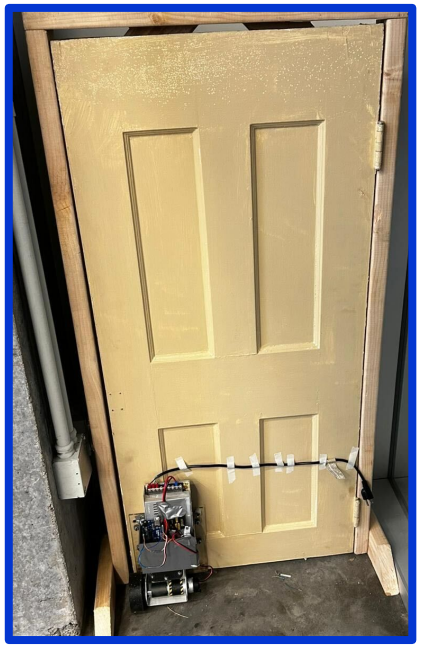
04

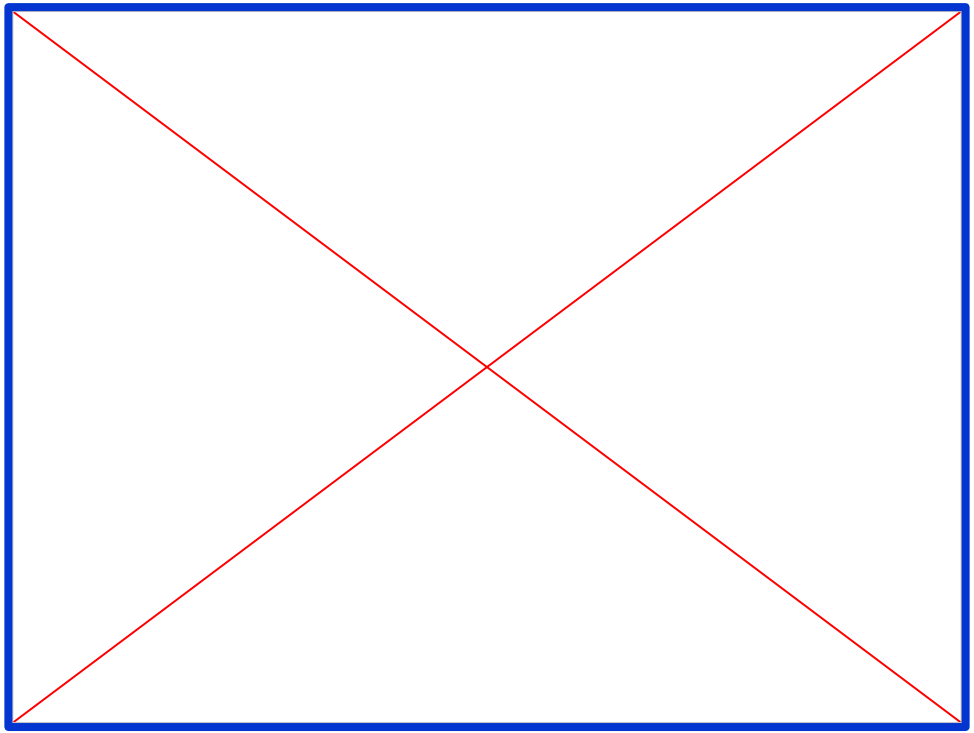
Hinge

Overview:

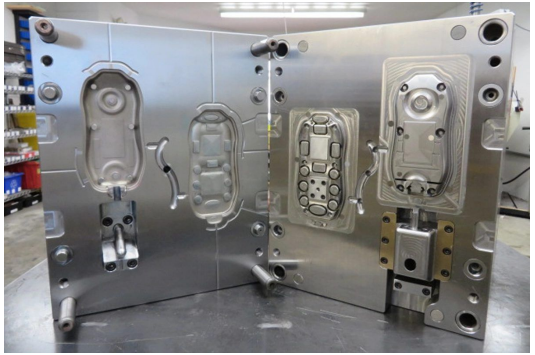
- Aluminum hinge with spring
- Provides normal force required for traction
- Accommodates uneven flooring

Final Design & Demo



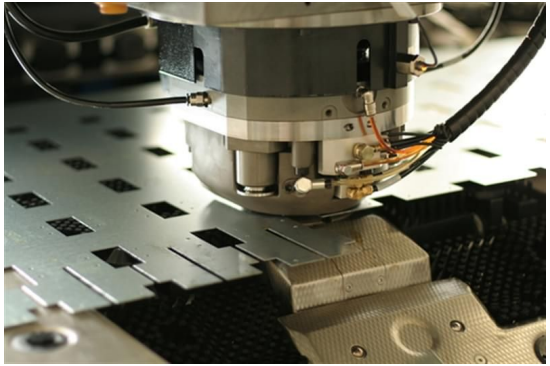


Mass Production



Injection Molding
(electronic box & mounting plate)

-Production efficiency
-Cost effective



Stamping
(motor mount)

-Cost effective
-High production volume
-Consistency

Pricing

$100

Cost of Manufacture

- Components sourced at retail pricing
- Expected increase in profit w/ scaled production and bulk sourcing

$200

Per unit

$100

Profit Margin

1,000

Yearly Projection

$100,000

Yearly Profit

Thank You!

Questions?