Door Opener Project

Sponsor: College of Engineering and Technology, Utah Valley University

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Coach: Dr. Sean Tolman

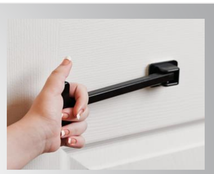
Problem Definition

Design a product to enable independent door opening and closing capabilities for a paralyzed client at his personal home with no assistance while ensuring normal functionality of the door within UVU's provided budget by the end of April.

Market Research

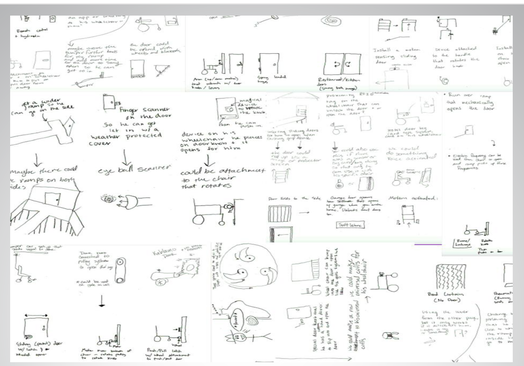
- The team explored previous products on the market
- Market research helped the team during concept generation to develop new ideas
- Related patents were investigated to ensure we didn't have any infringement issues





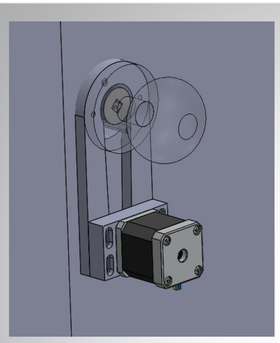


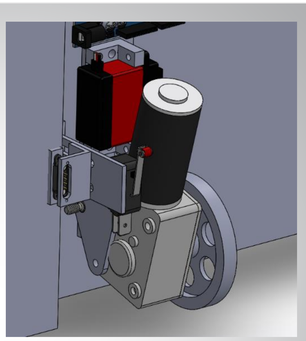
Concept Generation



- 6-3-5 Method was used for concept generation
- Screening matrix was used based on design requirements from the team
  - Average score was used to decide if a concept moved forward to the scoring matrix or was no longer continued
- Scoring matrix was used to narrow down to the top 2 concepts
  - Presented the top two concepts to Thomas to get his preference

Selected Solution

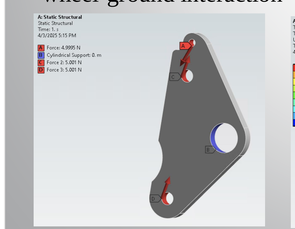


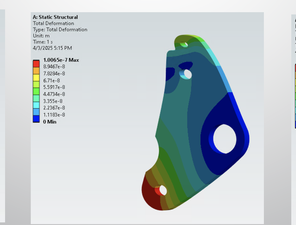


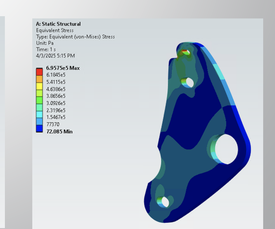
- The design includes two pieces:
  - A motor that rotates the spindle to release the latch
  - A wheel at the base directly under the doorknob to pull the door open
- This will be combined with an Arduino and smart switch to electronically control the mechanisms
- The smart switch will integrate with an iPhone to open and close the door

Testing & Analysis

- Mesh: Tetrahedrons Method, Body Sizing of 0.0005m
- Force A = Force from the servo arm
- Support B = Allows the piece to rotate about the pin, but no movement in either of the other planes
- Force C & D = Normal forces applied through the motor from the wheel-ground interaction
- Total deformation won't affect the contact of the wheel with the ground during use
- Maximum stress is 6.9575×10^5 Pa which is low enough for aluminum that it should not break or plastically deform
- Safety factor of 15 and fatigue life of 1×10^8 means this will last a long time before any noticeable wear occurs

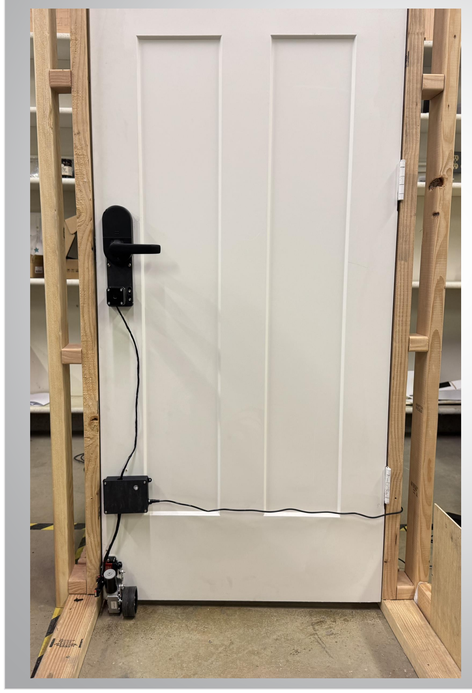


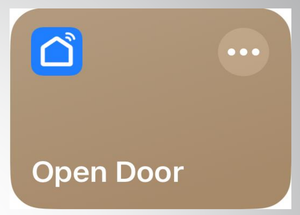




Final Product

- Smart Integration
  - Voice activation using a Siri command triggers the smart switch sequence
  - Smart switch initiates Arduino code to begin open door process
  - Alternate voice command closes the door





- Design Refinement & Optimization
  - Geared stepper motor
  - Cable management
  - Electronics casing
  - Servo saver
  - Smart locking door handle (exterior use)
  - Timer for soft close
  - Time limit added

Product Support

- An Instruction Manual was created to provide support to the consumer after we graduate, including:
  - Bill of Materials
  - Smart Home Integration Steps
  - Product Assembly Instructions
  - Arduino Setup
  - Links to Arduino code
  - Files for designed parts (both 3D printed and laser cut)
- On April 19th, the group went down to Ferron, UT and setup the modules on seven doors ensuring functionality and smooth incorporation