Elevator Controller for Individual with Multiple Sclerosis
Product Design Specification

Team Members:
Michele Lorenz (Team Leader)
Emily Maslonkowski (Communicator)
Ashley Matsick (BWIG)
Sara Karle (BSAC)

Primary Contact:
John O. Fleming, MD
Professor, Vice Chair, Neurology
Professor, Medical Microbiology and Immunology
University of Wisconsin Medical School
Department of Neurology, H6/564 CSC
Phone: 608-263-5421
email: fleming@neurology.wisc.edu

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Problem Statement/Function:
Our project involves the design of a device capable of covering the distance from a wheelchair to an elevator call button in the x, y, and z directions, then exerting a horizontal force sufficient to successfully push the call buttons in both the standard elevator car and the corresponding hallway. The mechanism must either be directed by infrared signals (to be later integrated into a voice-controlled adaptive technology system) or be controlled by another stimulus generated by movement no lower than the user's neck.

Client Requirements:
- Device must be able to push normal elevator buttons both inside and outside of the elevator, including the alarm button
- Optimally, this device will be integrated into the patient's voice-activation technology to minimize the necessity of muscle involvement (cannot make use of any limbs)
- Device does not need to be universal with respect to the elevator controls in other buildings

Design Requirements:
1) Physical and Operational Characteristics
   a) Performance
      - Used multiple times daily
      - Ability of pushing component to exert a minimum force of 2 lbs, preferably 4-5 lbs
   b) Safety
      - Can't alter normal wheelchair or elevator operations
      - Forces exerted by moving parts should not endanger the user or bystanders
      - Device should be capable of pressing help button in case of emergency
      - Device controls should not compromise ease of use of current wheelchair controls
   c) Accuracy & Reliability
      - Should be able to move to a specific button based on the input of the user
      - Should provide visual feedback about the position of the pushing component

- Device should operate in the vertical direction at a speed conducive to making small adjustments

d) Life in Service
- 10 years or until upgraded parts are available
- Individual parts should be easily serviceable as needed (including batteries)
- Each individual part should withstand use at least 5 times per day

e) Operating Environment
- Weatherproof: temperature ranges from 20-90 degrees Fahrenheit, humidity and rain
- Must withstand vibrations and dust upheaval caused by wheelchair motion, especially over uneven/bumpy terrain

f) Ergonomics
- Should not require physical interaction, with the exception of head/mouth movement

g) Size
- Total width of chair and device may not exceed 35” and should be significantly less to avoid unnecessary maneuvering by the patient
- Height of device should be minimized while in storage
- Additional dimensions of device should not cause unnecessary adjustments to normal movement (turning corners, etc.)

h) Weight
- Device should not compromise the existing stability of the wheelchair

i) Materials/Aesthetics & Appearance
- Exterior materials should be weatherproof
- Simple user interface
- Uncluttered components

2) Production Characteristics

a) Quantity
- One unit needed for individual client

b) Target Product Cost
- Minimize overall cost, preferably under $200
- Manufacturing/parts costs
  (1) Linear actuator - $100
  (2) Solenoid - $10-30
  (3) Miscellaneous - $20
  (4) Metal – free scrap + $30

3) Miscellaneous

a) Competition
- Patent searches returned no similar devices (but components may be individually patented)

b) User Preferences—Control
- User prefers device be controlled using preexisting infrared signaling so voice commands can be used