ELEVATOR CONTROLLER FOR INDIVIDUAL WITH MS

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abstract

The goal of this project is to create a device that will enable an individual with limited mobility to press elevator call buttons in multiple hallways, as well as the internal elevator control buttons. Design constraints are defined by the environment in which the device must operate as well as the user's physical capabilities. The mechanical components of this project are the main focus of this semester, with signal integration and attachment to the wheelchair as secondary stages we plan on developing in the future. While we drafted three designs to fulfill the initial requirements defined by the client and user, subsequent alterations to the constraints dictated the development of a completely novel final design, a 6-bar mechanism attached to a vertically telescoping arm.

problem definition

Multiple Sclerosis

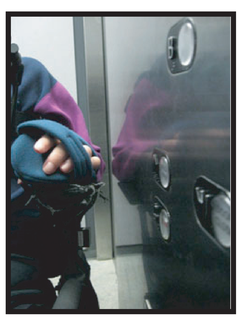
- Autoimmune disease
- Symptoms typically occur in early to mid adulthood
- Immune system attacks myelin
- Impairs ability of brain to communicate with muscles
- Muscle atrophy is a secondary effect

Loss of motor control in upper limbs necessitates the design of a device to perform simple tasks (i.e. pushing an elevator button)

design criteria

- Must be able to aim at and push both hallway and interior elevator buttons, covering a horizontal distance of at least 5 inches
- Should be controlled by voice command or movement localized above the user's neck
- Does not need to be universal with respect to the elevator controls in other buildings
- Should not compromise ease of use of current wheelchair controls
- Should operate in the vertical direction at a speed conducive to making small adjustments
- Total width of chair and device may not exceed 35" (an additional 7" wider than the chair) and should be significantly less to avoid unnecessary maneuvering by the user
- Height of device should be reduced while in storage
- Minimize overall cost, preferably under $200

Knee curve of user's wheelchair lined up with elevator buttons in user's building.



User's wheelchair in optimal position, parallel to the elevator wall containing the buttons.

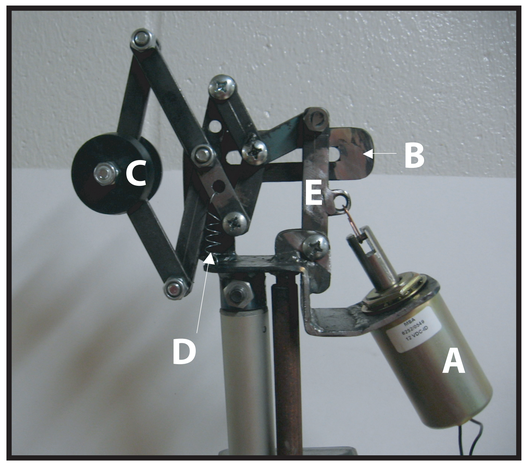
references

Campbell, Neil A., and Jane B. Reece. Biology. 7th ed. San Francisco: Benjamin Cummings, 2005. 1012-1015.

P., D. Personal interview. 31 Jan. 2006.

The National Multiple Sclerosis Society. 2006. 29 Jan. 2006 <http://www.nationalmssociety.org>.

final design



Close up view of the six-bar mechanism detailing solenoid (A), horizontal guide (B) rubber cylinders (C), retraction spring (D), and lever arm (E).

- After considering designs with either a linear or rotational pushing mechanism, we concluded that a device travelling perpendicular to the plane of the buttons would be the most accurate and user-friendly option.
- Vertical adjustments are achieved with the use of a linear actuator that extends 12" at approximately 0.4" per second.
- The horizontal motion and force needed to activate an elevator button are supplied by a six-bar mechanism powered by a pull solenoid with a 1" stroke.
- Storage position is maintained by the force of a small spring.
- Currently, vertical motion is controlled by a toggle switch while horizontal extension is activated by a momentary contact switch.
- Device is powered by a 12 volt battery.

future work

- Resolve linear actuator discrepancy between advertised 12" stroke and current 7.5" extension
- Mount device on user's wheelchair
- Connect wheelchair battery as source of power for device
- Test device in user's environment (elevator and hallways)
- Apply markings to linear actuator rod to indicate proper alignment between device and desired buttons
- Incorporate user-friendly controls (voice command or no-pressure buttons)
- Weatherproof entire device

project progression