Adjustable Back Angle Controller
(A.B.A.C.)

Funded by the RERC

TEAM 8
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Outline

- Overview
- Statement of Need
- Design Features
  - Device Layout
  - Subunits
  - Flowchart
- Budget
- Timeline
- Impact on Society
- Conclusion
RERC sponsors the **2006/2007 National Student Design Competition**

- Funded by National Institute for Disabilities and Rehabilitation Research
- Chosen Design Area: Accessible Power-Assist Hospital Bed Back Angle Controller
Overview

- To design a reliable, easy-to-use, back angle controller
  - Safe
  - Low profile
  - Low noise
  - Low cost
- Designed to accommodate patients and caretakers of all ability levels
Statement of Need

- To adjust the patient with minimal effort
- To reduce stress on caretaker

  - 36% of back injuries in nurses are due to patient handling

Accommodates Client’s Needs

- Visual Impairment – Mat & Akiko
- Parkinson’s disease – Lakisha
- Arthritis – Dolores
- Limited Strength – Sani & Tyler
- Chronic Back Pain – Jorge
Typical Bed Control

Invacare©

- Full-electric Hand Pendent
- uses a series of open-loop switches to adjust the legs and back of the bed
Design Features

- *Extended Physiological Proprioception (EPP) concept*
  - Intuitive design
  - Force sensitive (1-20 lbs input)
- Variable speeds
- Handle
  - Easy to find & Operate
  - Safety locking mechanism
- Electro-mechanical lift system
Device Layout

Back View

Side View
Device Layout

SIDE VIEW, Angle @ 0 degrees
Handle Design

Inside box containing circuit board, springs, and output wires to power dc motor

Control Lever with push-to-activate switch inside handle for safe operation

Safety Switch

6"

18"
Figure 6: Electric Circuit Overview
Figure 6: Electric Circuit Overview
Circuit

- Generates Triangle Wave
- Compares to Reference Voltages
- Creates Square (PWM) Wave
Figure 6: Electric Circuit Overview
Figure 6: Electric Circuit Overview
MOSFETS
MOSFETS
Motor Selection

- Torque
  - \( \text{Max Torque} = 0.177 \times \text{Max Force} \times \text{Thread Pitch} \)
  - \text{Estimated Torque Needed: 75 ft-lb}

- Power
  - \( \text{Power} = \frac{\text{Force} \times \text{Thread Pitch} \times \text{Rotational Speed}}{3.564 \times 10^5} \)
  - \text{Estimated Power Needed: 0.5 hp}
Lifting System

- Scissor Jack
  - Typically Used as an Automobile Jack
  - Only 200lb Lift Needed
  - Provides Large Vertical Movement while Collapsing to Low-Profile
<table>
<thead>
<tr>
<th>Parts Involved</th>
<th>Price Range</th>
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<tbody>
<tr>
<td>Aluminum for Handle and Framing</td>
<td>Approx. $50</td>
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<tr>
<td>Control Mechanism</td>
<td>Approx. $85</td>
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<td>Compression Springs (10)</td>
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<td>Scissor Jacks (2)</td>
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<td>Misc. (Bolts, attachments, etc.)</td>
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<td>Bed Frame Supplies</td>
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<td>DC Motor</td>
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<td>Mosfets (6)</td>
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<td><strong>Total</strong></td>
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Timeline

- Receive Parts & Build Prototype Bed by Week 3
- Troubleshoot and Test Circuit by Week 6
- Assemble PCB & Integrate Handle by Week 9
- Complete Assembly & Begin Device Testing by Week 12
- Complete Final Report by Week 14
- Final Presentation & Demonstration Week 15
Impact on Society

- Reduce Healthcare Employee Injury Rate
- Provides Independence to People of all Disabilities
  - Minimizes Caretaker Responsibilities
  - Provides Peace of Mind for Loved Ones
- Accommodates Clients
Conclusion

- **Ease of Use**
  - Simple, Ergonomic Control

- **Provide Variable Adjustment Speed**

- **Smooth and Quiet Operation**
  - Electric Control
  - Quiet Motor

- **Minimal Cost**
Acknowledgements

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Questions?