Self-Powered Lifting Manual Wheelchair

2.009 Green A

Sketch Model Review

October 5, 2006

Customer Need

- **Increase COMMUNICATION**
- **Extended reach**
- **Low cost**
- **Low weight**

- **Typical Customer:**
  - Long-term wheelchair user with upper body mobility
  - Desires independence at low cost
  - Interaction with family and friends

Market Composition

- **Wheelchair users in U.S.[1] – 1.6 million**
  - Electric Chairs: 155,000
  - Manual Chairs: 1.5 million
- **Demand surveys & local clientele**
  - Independence Technology iBOT
  - MIT's Disabilities Services Office
  - MIT's Medical Center: Health & Wellness Office
  - Wheelchair Design for Developing Countries

1. UCSF Disabilities Statistics Center http://dsc.ucsf.edu/publication.php?pub_id=1

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Market Benchmarking

Invacare Formula TRE[1]: $1,895

Independence Technology iBot[2]: $26,000

1. http://www.invacare.com
2. http://www.ibotnow.com

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Design Alternatives

Require no battery or external power

- **Compression Spring System**
  - Large additional mass
- **Counterweight System**
  - Destabilizes chair
- **Ratchet / Self-Lift System**
  - Extra exertion by user
- **Pneumatic System**

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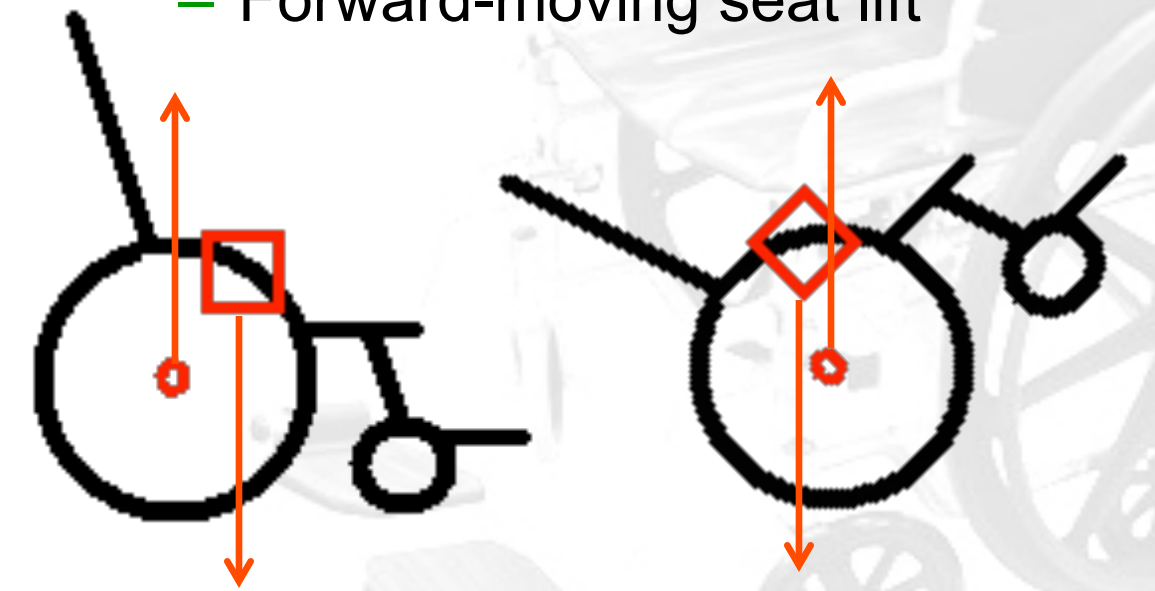
Technical Feasibility

- **Assumptions:**
  - 100 kg load (Person + elevated chair)
  - 2 charging pistons
  - Length of piston cylinder: 15 cm
  - Diameter of piston cylinder: 5 cm
  - Pump stroke: 5 cm

- **Maximum Pressure: 500 kPa (72 psi)**
- **Wheel Rotations: 9 rotations ~ (17 meters)**

Issue #1: Stability

- **Center of gravity location critical**
- **Design options**
  - Retractable back support
  - Forward-moving seat lift



STABLE **UNSTABLE**

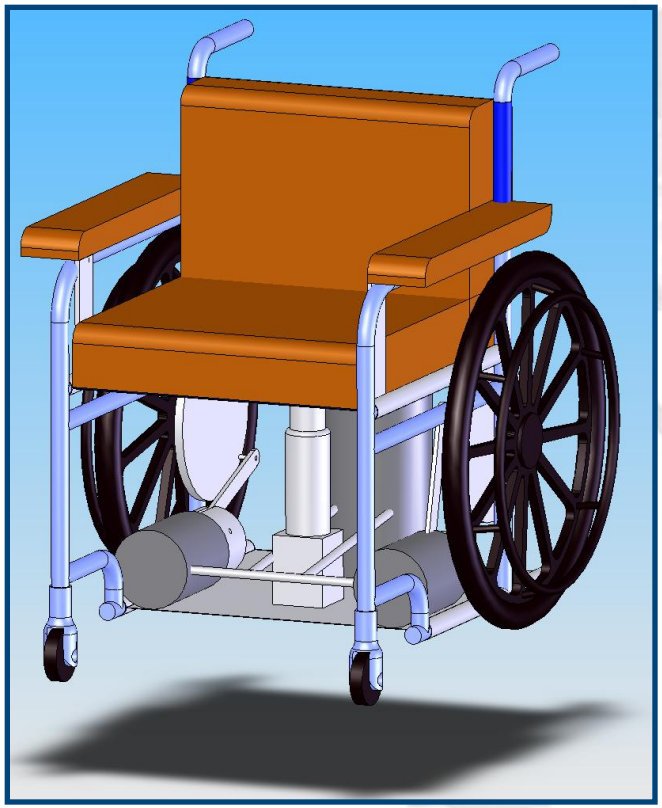
TIPPING ANGLE

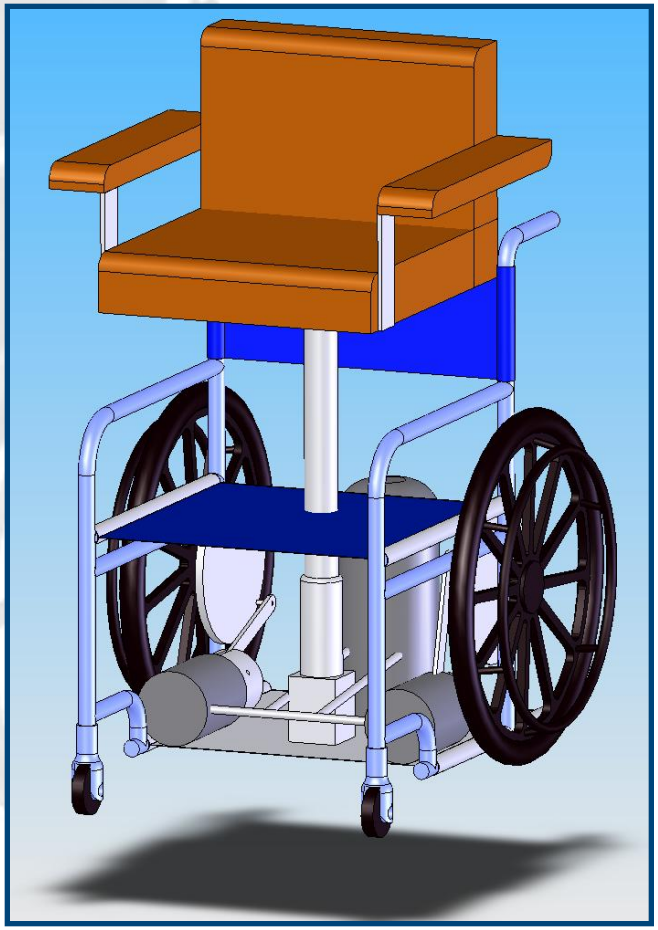
Regular = 35°

2 ft Lift = 2°

Issue #2: Self-Pressurization

- Back Pressure → Wheel Torque
- Gearing





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