Chair Force One

Mockup Presentation
CF1 is a manual wheelchair that provides power assistance

The hand rims sensors detect user-applied forces...

...and send a boost signal to the motorized wheels

Purple B
Scenario 1

Maria is a new user who needs to build up arm strength
Scenario 2

Atissa becomes fatigued after travelling far every day
Scenario 3

Dave wants to retain the independence of a manual wheelchair, but doesn’t have the strength to use one
Scenario 4

Richard worries that he won’t be able to apply enough force if his hands slip on the rims.
Key Risk

• Can we keep our boost system within user’s weight constraints?
  – Determine the **ideal boost assistance and component weights**
  – Identify **motors and batteries** that fall within tested user constraints
User Testing for Ideal Boost

- ADA compliant ramp
- Pulley system applies force on wheelchair
- Blind weight test
- 18 lbs of boost = 4.75 Nm, 24” dia. wheel
User Interviews

• Must be sleek and lightweight
  – Easy to get into a car
  – Boost takes care of the motor and battery weight

• Must be able to negotiate
  – 20+ ramps per day
  – 60 minutes of constant travelling

• Must be easily chargeable
Sizing Motors and Drivetrain

- Benchmark
- Fisher Price 00768 motor
- 181:1 Gearbox
- 1.5 lbs each
- Back-drivable
- 3.8 Amp @ 4.75 Nm
Energy Storage

50 W-h required
60 minutes at 100% duty cycle

<table>
<thead>
<tr>
<th></th>
<th>Saft NiMH</th>
<th>Eagle Picher SLA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>VH D 10S</td>
<td>CF-12V4.5</td>
</tr>
<tr>
<td>Voltage</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Size (ft^3)</td>
<td>0.022</td>
<td>0.45</td>
</tr>
<tr>
<td>Energy (W-h)</td>
<td>54</td>
<td>108</td>
</tr>
<tr>
<td>Weight (lbs)</td>
<td>3.75</td>
<td>4.63</td>
</tr>
</tbody>
</table>
Weight of System

3 lbs – motors and drivetrains
+ 4 lbs – battery
+ 1 lb – electronics and housings (est.)

8 lbs – total
# Product Contract

<table>
<thead>
<tr>
<th>Customer Need</th>
<th>Product Attributes</th>
<th>Engineering Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Can be lifted into car</td>
<td>Weight</td>
<td>&lt; 10 lbs. additional weight</td>
</tr>
<tr>
<td>Sufficient boost for user comfort</td>
<td>Motor torque</td>
<td>4.75 Nm each</td>
</tr>
<tr>
<td>Functions for a full day</td>
<td>20 x 12’ ramps + 60 min</td>
<td>50 W-h battery</td>
</tr>
<tr>
<td>Control safety</td>
<td>Motor controller</td>
<td>Fail-safe off; no false direction triggers</td>
</tr>
<tr>
<td>Speed safety</td>
<td>Speed limit</td>
<td>5 mph</td>
</tr>
<tr>
<td>Reliable</td>
<td>MTBF</td>
<td>1 year</td>
</tr>
<tr>
<td>All-weather</td>
<td>Resistant to water and temperature variations</td>
<td>NEMA 4X, -20 to 110°F</td>
</tr>
<tr>
<td>Value</td>
<td>Cost</td>
<td>$1000 beyond manual chair</td>
</tr>
</tbody>
</table>
We can’t wait to show you CF1!