Body Cooling System

Review I
Team Members

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Figure 1: P16013 team members
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Team Values & Norms

- **Values**
  - Punctuality
  - Reliability
  - Realistic Expectations
  - Transparency

- **Norms**
  - Punctuality
    - Arrive on time to team meetings
    - Arrive ten minutes early for meeting with individuals outside of the team
  - Communication
    - Main form of communication is email
    - Text team members if important or urgent
  - Professional and Ethical
    - Always cite your sources
    - Document completed tasks on team spreadsheet
    - Honestly review each other’s work
Project Background

Figure 2: Various cooling devices available in today’s market.
Problem Statement

- Studio 2.0 will create a passive body-cooling device for individuals who have Multiple Sclerosis (MS)
- Team P16013 will design a testing apparatus to test different garments, materials and body placement for ideal cooling parameters

Project Deliverables

- Testing rig for the body-cooling device
- Tested body-cooling prototype
Stakeholders

Al Sigl Community of Agencies

National Multiple Sclerosis Society

R·I·T Collaborations technology + creativity + community
Use Scenarios

Person with heat related illness puts on cooling system before entering warm environment

User removes device and recharges it for next use

Cooling System provides relief to user, preventing overheating

User wears cooling system until in a safe temperature environment

Figure 3: Use scenario for the cooling device.
## Customer & Engineering Requirements

<table>
<thead>
<tr>
<th>Rqmt. ID</th>
<th>Customer Requirements</th>
<th>Category</th>
<th>Importance</th>
<th>Engineering Metrics</th>
<th>Unit of Measure</th>
<th>Target Value</th>
<th>Verification Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>CR1</td>
<td>Light weight</td>
<td>Physical</td>
<td>9</td>
<td>Total Weight of Device</td>
<td>lbs</td>
<td>&lt; 3 lbs</td>
<td>Weigh using scale</td>
</tr>
<tr>
<td>CR2</td>
<td>Unnoticeable or fashionable</td>
<td>Physical</td>
<td>9</td>
<td>% of observers who notice device</td>
<td>%</td>
<td>&lt; 10%</td>
<td>Survey Observers</td>
</tr>
<tr>
<td>CR3</td>
<td>Comfortable</td>
<td>Physical</td>
<td>3</td>
<td>Time worn and deemed comfortable (score &gt;=4 out of 5 on comfort scale)</td>
<td>Subjective ranking</td>
<td>5</td>
<td>Survey users</td>
</tr>
<tr>
<td>CR4</td>
<td>Test for optimal pack size</td>
<td>Physical</td>
<td>3</td>
<td>Flexibility</td>
<td>Subjective ranking</td>
<td>5</td>
<td>Survey users</td>
</tr>
<tr>
<td>CR5</td>
<td>Allergy conscious</td>
<td>Functional</td>
<td>1</td>
<td>% Composition of Latex</td>
<td>Percentage</td>
<td>0%</td>
<td>Observation</td>
</tr>
<tr>
<td>CR6</td>
<td>Fast recharge</td>
<td>Functional</td>
<td>3</td>
<td>Time to refreeze after use</td>
<td>hrs</td>
<td>&lt; 2 hrs</td>
<td>Time process</td>
</tr>
<tr>
<td>CR7</td>
<td>Quick to put on/take off</td>
<td>Functional</td>
<td>3</td>
<td>Time to put on/take off device</td>
<td>mins</td>
<td>&lt; 2 mins</td>
<td>Time process</td>
</tr>
<tr>
<td>CR8</td>
<td>Moderates user’s body temperature</td>
<td>Functional</td>
<td>9</td>
<td>Time to cool user to comfort score &gt;=4 out of 5</td>
<td>mins</td>
<td>&lt; 5 mins</td>
<td>Use Thermometer &amp; Stopwatch</td>
</tr>
<tr>
<td>CR9</td>
<td>Test for body placement site that ensures quick and efficient cooling</td>
<td>Test Rig</td>
<td>9</td>
<td>Rate of body cooling (sedentary)</td>
<td>Deg C/min</td>
<td>0.1 Deg C/min</td>
<td>Use Thermometer &amp; Stopwatch</td>
</tr>
<tr>
<td>CR10</td>
<td>Test for ideal phase-change material substance</td>
<td>Test Rig</td>
<td>9</td>
<td>Net Energy Storage capability</td>
<td>Joules</td>
<td>340J</td>
<td>Thermometer</td>
</tr>
<tr>
<td>CR11</td>
<td>Test for optimal material thickness</td>
<td>Test Rig</td>
<td>9</td>
<td>Time of effective cooling</td>
<td>hrs</td>
<td>&gt; 6 hrs</td>
<td>Stopwatch</td>
</tr>
</tbody>
</table>
Project Risks

Technical Risks:
- Phase change material must be thicker than specified to provide adequate cooling
- Garment becomes heavier than specified to meet required cooling specifications
- “Freeze” temperature is not adequate to meet the cooling specifications
- Testing apparatus does not accurately model the human body

Resource Risks:
- Availability/scheduling conflicts with ID team
- Phase change material is expensive and hard to get samples of
- Budget constraints based on allocation between engineering, design, and business teams
- Availability of an environmental control chamber for testing
Project Risks

Safety Risks:
- Patient is “burned” by cooling packs due to inadequate material lining between packs and skin
- Phase change material packs are punctured and user is exposed to material
- Garment makes user hotter or more fatigued and systems are exacerbated
- Cooling packs are used separately from garment
- Garment causes discomfort to user
- Garment does not cool user fast enough before symptoms set in

Environmental/Societal Risks:
- Phase change material is not properly disposed of causing environmental problems
- If device is not inconspicuous, users face a stigma associated with having a disability
- Garments are made of hard-to-obtain or non “green” materials and the device is not sustainable
- Phase change packs are not degradable or recyclable causing excess waste
Budget & Other Constraints

- Budget of $3,000
  - Shared with ID and business students
- Time - 32 weeks
- Safe for user
- Affordable
Questions?

Thank you for your attention.