**Temporary Stair Ascension Device – Drive System**

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**Client:** St. John’s Rehab Hospital, Dr. John Patcai, Dr. Murray Waldman

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**1 Why a Stair Ascension Device?**

*(Why) Existing commercial devices are infeasible; cost of $6,000-$8,000 is not justifiable for two to three months of use

*(What) St. John’s Rehabilitation Hospital (SJRH) is seeking a temporary stair ascension device to facilitate earlier discharge

*(Where) Device is aimed for two to three months of use at patients home

*(Who) Typical target users are patients suffering temporary lack of lower body strength to safely ascend and descend stairs

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**2 Design Objectives & Benchmarking**

Design generation and selection process includes nine separate drive systems. We conducted quantitative benchmarking of the design alternatives against the design objective.

Benchmarking of top four design alternatives against design objectives:

<table>
<thead>
<tr>
<th>Objectives</th>
<th>Hand-cycle on track</th>
<th>Wheelchair supported by spokes</th>
<th>Counterweight-driven on track</th>
<th>Motor and cable on track</th>
</tr>
</thead>
<tbody>
<tr>
<td>Independently operable</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Propel a 140 kg user</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Move smoothly &amp; efficiently*</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Fail-safe (ranking)</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Simple &amp; Feasible (ranking)**</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>

* More efficiently: trip duration is less than two minutes  
** Feasible: overall system should cost less than $2,000

✓ Concept accepted for prototyping: Motor and cable system was found to best meet the design objective.

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**3 Solution to Temporary Stair Ascension**

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**4 Future Work**

Further research needs to be conducted at St. John’s Rehab Hospital to proceed with the next stages of the product development process.

The following two lists summarize important future work to be conducted:

A. Prototype Improvement:
   i. Optimize safety factor to improve feasibility
   ii. Improve ease of installation
   iii. Conduct research on noise level of the system
   iv. Further develop the system to allow for use on curved staircases
   iv. Conduct failure modes and effects analysis (FMEA)

B. Implementation:
   i. Survey potential users to improve knowledge of user needs and to anticipate user adoption of the solution
   ii. License as a lifting device
   iii. Plan outsourcing of materials (off-the-shelf)

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**5 Result and Conclusion**

We managed to extend the philosophy followed in rehabilitation of individuals with temporary disability to the design of a feasible, simple, and reliable stair ascension drive system.

The brilliance of the solution lies in its simplicity.

The characteristics of the drive system make it fit well within the rehab atmosphere, while meeting the design objectives and constraints; as such, it is expected to receive high acceptance by rehab patients.

The simple ergonomics of the system make it easy for therapists to train patients, and for patients to use the system.

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