Barracuda Innovations: Power Pad

Objective

Customer Requirements
- Must not cause a safety hazard
- Durability
- Require very low maintenance
- Attractive Appearance
- High energy conversion efficiency

Constraints
- Must not tire or inconvenience user
- Must fit in common walking paths

Concept Generation

Final Concept
- Mechanical design
- Visually interesting
- Manufacturing is very simple
- Accepting of any force inputs

Magnetic Flux design
- Simple design makes assembly and manufacturing easy
- Depends on an input impulse

Capacitor design
- Manufacturing a high capacitance capacitor is difficult
- Simple, least mechanical components

Engineering Characteristics
- Maximum load of 500lb
- Maximum displacement of 15mm

Design

Operation
- Energy from the step is harnessed by the flywheel
- Energy in the flywheel is fed through a gearbox then generator to create electricity

Prototype and Testing

Description
- Machined shaft and flywheel
- Lego gearbox and generator
- Built to scale

Testing
- Measured voltage across load resistor in LabVIEW

Results and Future Work

Product Design Process
- Recognized opportunity and identified customer requirements
- Determined targets and limits in House of Quality
- Developed concepts from benchmarking and innovative thinking
- Designed a device that generates electricity from a footstep

Recommendations for future design
- Maximize torque from step input
- Improve energy conversion efficiency
  - Optimize flywheel size and shape
  - Optimize spring and damper system for restoring pad

Process Reflection
- House of Quality produced targets and constraints for design
- Concept generation developed multiple design options
- Embodiment design supported product feasibility
- Prototyping proved concept, but highlights challenges

General need for Product
- To promote awareness of renewable energy among the general public
- Sustainable energy source that can be used to help power LED displays for advertisements and other information.

Market Size
- Metropolitan cities, museums, schools, universities, companies that want to promote their sustainability initiatives, etc.
- Over $600 million was spent on corporate sustainability marketing last year

Key Features | Functionality
---|---
Single-Direction Bearing | Limits only the down-force as input and keeps the flywheel spinning in only one direction.
Flywheel | Stacks inputs from various steps to limit losses
High ratio Gearbox | Quickly drains energy from the flywheel to prepare for the next step

Energy Generated (J) 0.015
Energy Generated (kWh) 4.17E-09

Output per Step
- Max Voltage (V) 3.26
- Max Current (mA) 21.88
- Max Power (mW) 71.41
- Energy Generated (J) 0.015
- Energy Generated (kWh) 4.17E-09

Design Characteristics

<table>
<thead>
<tr>
<th>Selection Criteria</th>
<th>Weight</th>
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</thead>
<tbody>
<tr>
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</tr>
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<td>Durability</td>
<td>0.12</td>
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