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Pedometer Energy Harvester Proposal

Team Pinnacle

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Outline

- Introduction
- Problem Statement
- Current Status of Art
- Solution Approach
- Project Management
- Conclusion & Questions

Introduction

- The need for environmentally friendly energy solutions drives the need for a system like the Pedometer Energy Harvester.
- The PEH harnesses power from the bodies of young/active persons for use as a power source.

Problem Statement

- Design a PEH that:
  - ☑ is portable
  - ☑ detects and converts human motion into electrical energy.
  - ☑ stores harvested energy for use in recharging electrical accessories

Design Requirements

The PEH should:

- Generate 5Vdc @50 – 100mA (or 12V version)
- Charge battery up to 5 WHr
- Operating Temp: -10 – 40 Celsius
- Deliver Power: Nominal to a USB device, Large to battery
- reserve
- Provide external indicator of power condition

Current Status of Art

- Sanyo's Pedometer Charger

- Ugly Sneakers Power Generator

- Knee Brace

Current Status of Art

- Knee Brace

Nominal power output:	8-14W (1.5m/s walking sped)
Maximum power output:	25W (15 degree down slope)
Effort Level setting:	10 levels
Output voltage:	5V to 16.8V (2 to 4 Li Ion cells)
Maximum output current:	5A
Operating temperature:	-20C to + 50C
Storage temperature:	-40C to + 70C

Solution Approach

- Using Faraday's Law of Induction, we intend to use a magnet that passes through a metal coil which, when you move, induces voltage in the coil generating electricity.
- The generated electric energy will then be stored in a rechargeable battery for use by the owner.
- An adapter will be added at the other end of the battery for whatever suitable connector the user desires.

- Theory Behind the Mechanism

- Faradays law states "*if a flux passes through a turn of a coil of wire, a voltage will be induced in the turn of wire that is directly proportional to the rate of change in the flux with respect to time".* In equation form,

$$e_{ind} = -\frac{d\phi}{dt}$$

Where,

e_{ind} = *voltage induced in the turn of the coil*

ϕ = *flux passing through the turn*

If the coil has *N* turns and if the same flux passes through all of them, then the voltage induced across the whole coil is given by,

$$e_{ind} = -N\frac{d\phi}{dt}$$

Where,

$N = Number\ \ of\ \ turns\ \ ofwire\ \ in\ \ coil$

Solution Approach Breakdown

- Power Generation
- Power Transmission
- Power Storage

Power Generation

A large NIB magnet

Coil Form

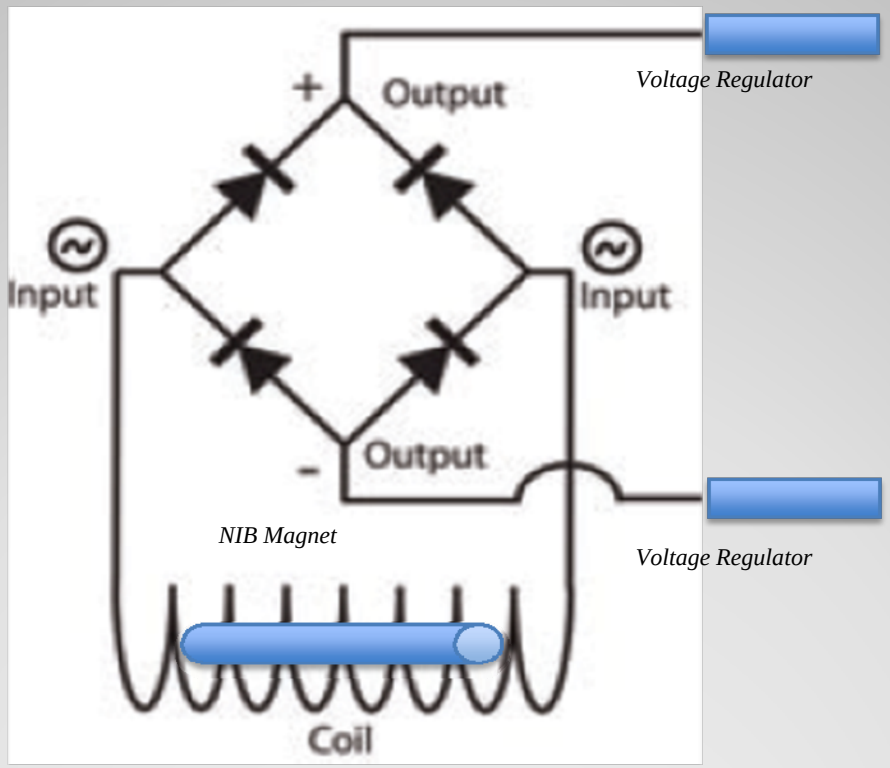
Magnet

The magnet is the most powerful type available for consumer use. It is a Neodymium Iron Boron, NdFeB or simply, NIB magnet. (Permeability = 1.05)

Coil

The heart of this system is the coil (and magnet). The movement of the leg will be used to slide the magnet back and forth to induce current through the coil

Power Transmission



Power Storage

Back-up Lithium Battery Pack

Outlets of Lithium Battery

Battery Capacity: 26.6Wh
output voltage: 5V
DC output: 100mA Max
Size: 5.2"x 3.1"x 0.6"
Weight: 0.606 lbs

Project Management

No	Tasks	Start Date
1	Research on existing energy harvesting systems	10/23/10
2	Select the most viable solution	10/27/10
3	1st. draft of proposal writing	10/26/10
4	Submission of 1st draft of proposal	10/27/10
5	Development of presentation	11/03/10
6	Online submission of presentation	11/03/10
7	Revision of proposal	11/11/10
8	Submission of proposal (hardcopy)	11/17/10
9	Research tool kits to help understanding	11/15/10
10	Research on potential hardware to be used	11/20/10
11	Submission of final proposal	12/01/10
12	Acquire identified hardware	12/05/10

Project Management

Deliverables

After completion of this project, we expect to meet the specified requirements set forth by Northrop Grumman:

- Detect & convert human motion into usable electrical energy

- Provide a portable power source that delivers power, nominal to USB device, large to battery reserve

Conclusion

Our current solution seems:

- Feasible
- Efficient
- Cost effective

Reference:

- Emily Alden, Mark Kennedy, Wolfgang Lorenzon, and Warren Smith*, An Electromagnetic Induction Flashlight Experiment, University of Michigan*, Ann Arbor, MI;Vol. 45, November 2007: 492-495.

- Richard J. Nelson, *The Forever Flashlight II - Batteries Not Required*, Excalibur Electronics, Inc, Miami, Florida.

- *PowerWalk™ M-Series*, Data Sheet, BionicPower:http://www.bionicpower.com/app_military.html.

Questions