Pedometer-type Energy Harvester

Bodunrin Jawando

Dhanushka Fernando

Illium William

WWW.MWFTR.COM

March 2011 | Senior Design Project | Howard University

Outline

HOWARD UNIVERSITY
1867
Leadership for America and the Global Community

- Introduction
- Problem Statement
- Design Requirements
- Solution Approach
- Project Management
- Project Update
- Future Work
- Questions

Introduction

- The need for environmentally friendly energy solutions is the major driver for a system like the Pedometer Energy Harvester
- The PEH harnesses energy 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

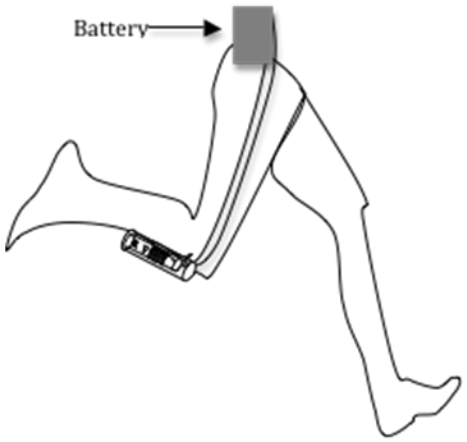
- Knee Brace

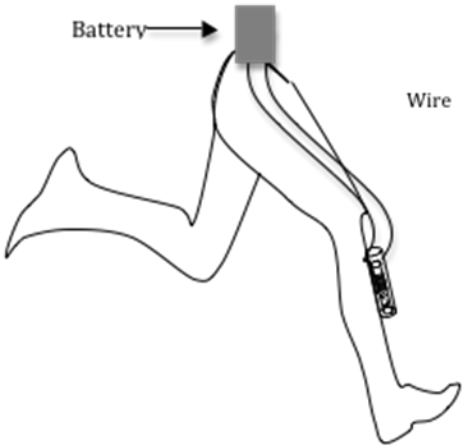
- Nominal power output: 8-14W (1.5m/s walking sped)
- Maximum power output: 25W (15 degree down slope)
- Effort Level setting: 10 levels
- Output voltage: 5V to 16.8V (2 to 4 Li Ion cells)
- Maximum output current: 5A
- Operating temperature: -20C to + 50C
- Storage temperature: -40C to + 70C

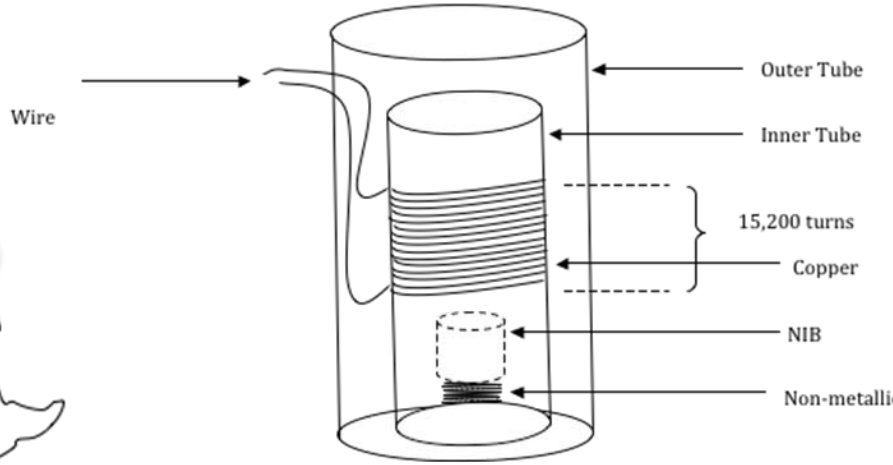
Solution Approach

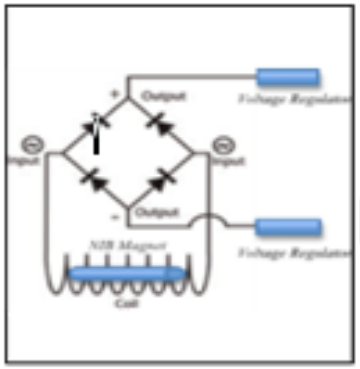
- Using Faraday's Law of Induction, we intend to use a magnet that passes through a metal coil which, when you move, induces voltage in the coil generating electricity
- The generated electric energy will then be stored in a rechargeable battery for use by the owner
- An adapter will be added at the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

Solution Approach

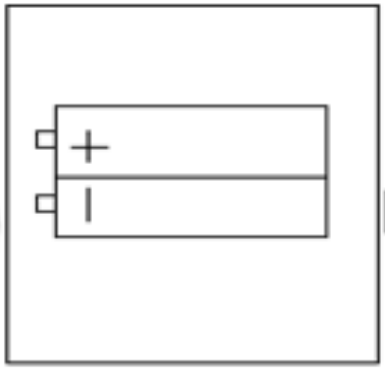








Transmission Circuit

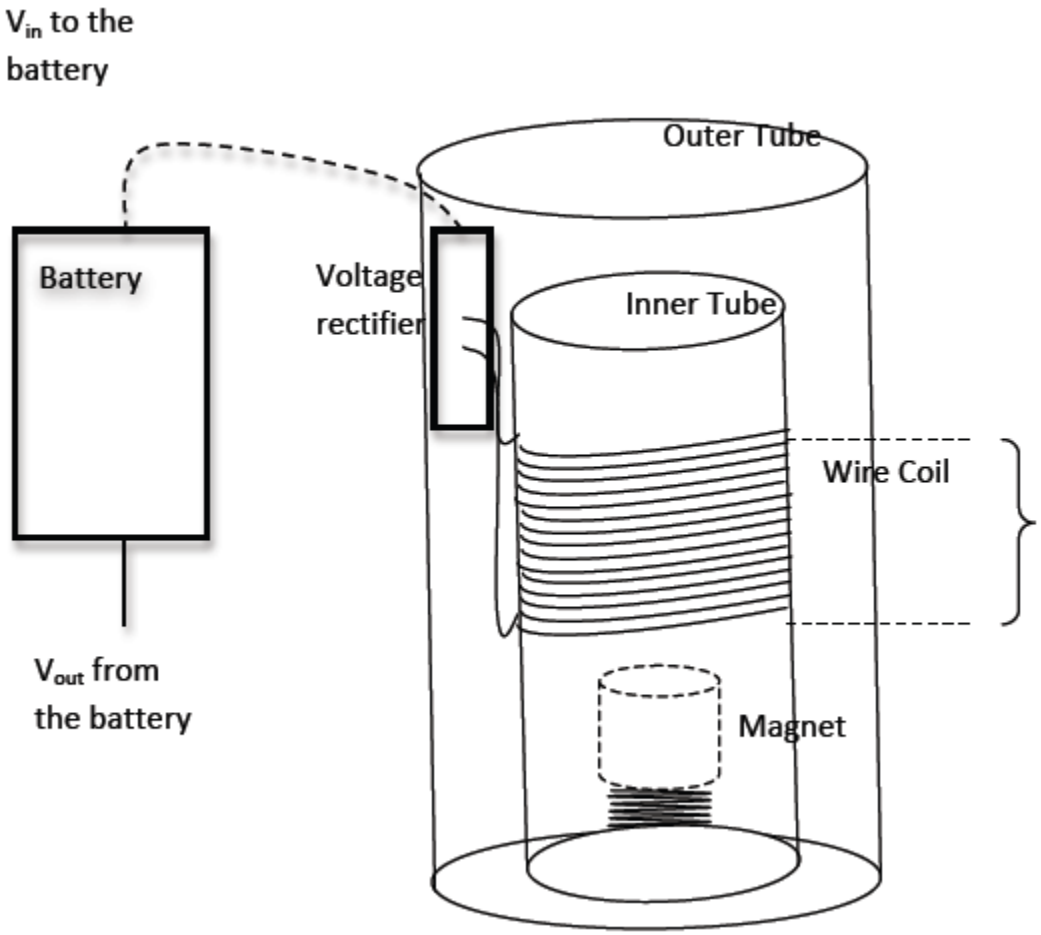


Rechargeable Battery

Multiple outlets for charging devices

Electronic devices

Solution Approach



Solution Approach

- Alternative Solution: Series Combination of Tubes

Pros

- More redundant than the single tube approach. One tube can act as a failover for the other

Cons

- More expensive
- Heavy

Solution Approach

HOWARD UNIVERSITY
1867
Leadership for America and the Global Community

- Alternative Solution: Toroidal Coil generator

Pros

- Require less turns of coil
- Continuous flow of current

Cons

- Time to construct
- Less Practical

Decision Matrix

Selection Criteria	Weight	Primary Solution	Several Tubes	Toroid Tube
Weight	5	3	1	4
Cost	5	4	2	2
Feasible	5	4	4	1
User friendly	5	4	3	1
Total	25	15	10	8

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

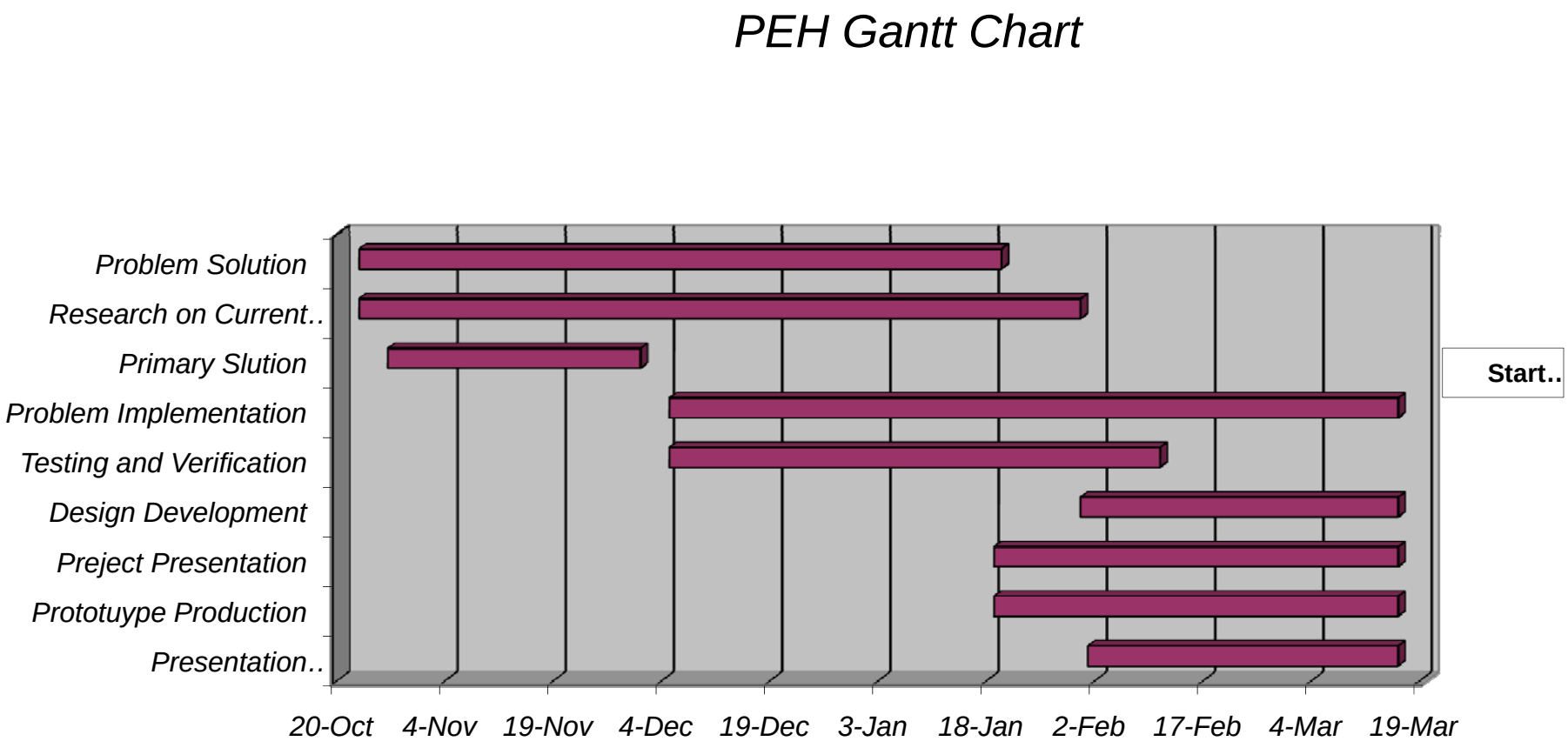
Project Management

Costs

- Magnets..... $10
- Wires.....$200
- Tubes.....$48
- Circuit Elements.....$20
- Battery.....$80

Total Cost = $358

Project Management



Project Update

HOWARD UNIVERSITY
1867
Leadership for America and the Global Community

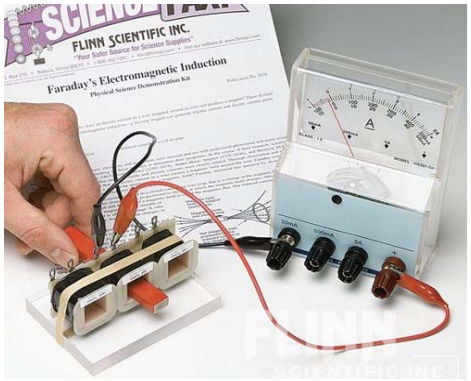
Gauge No	Diam. In Mils 1mil=1/1000 inch	Lbs. per 1000 ft.	Ohms per lb.	Feet per lb.	Ampacity	Ohms per lb.
26	15.94	0.7692	53.061	1300	0.5082	53.061
27	14.19	0.6100	84.371	1639	0.4030	84.371
29	11.26	0.3836	213.31	2607	0.2535	213.31

Table 1: Wire gage number and their specifications

Supporting Information

Coil Type	Current (A)	Voltage (V)	Power (W)
100	0.02	0.1	0.002
300	0.06	0.15	0.009
1000	0.09	0.2	0.018

Table 1: Results using Faraday's Electromagnetic Induction Apparatus



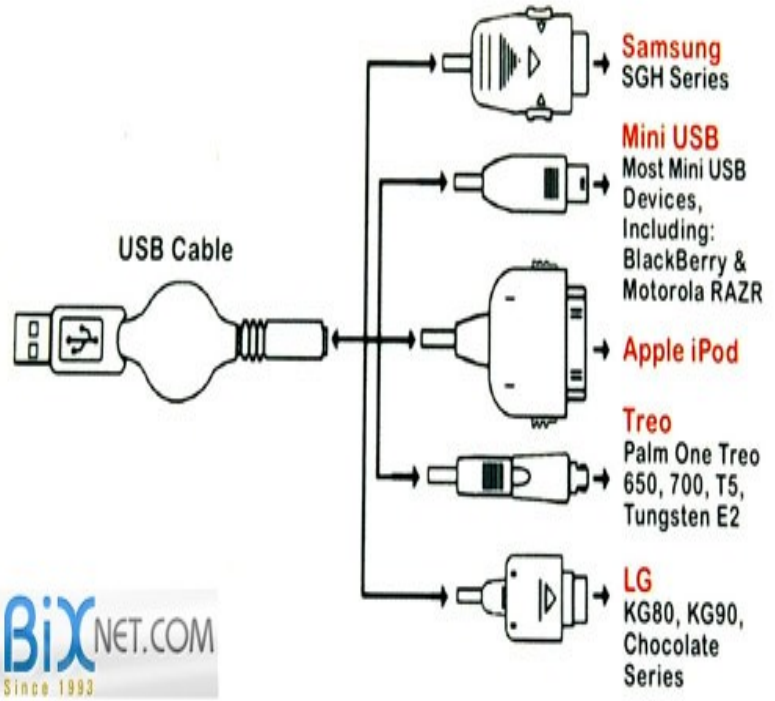
Coil Type	Current (A)	Voltage (V)	Power (W)
100	0.03	0.15	0.0045
300	0.08	0.2	0.016
1000	0.1	0.3	0.03

Table 2: Results using magnet from flashlight with kit

Project Update

Battery Type:	**Lithium-ion Cell**
Capacity:	**3400mAh**
Output Voltage:	**5.5v+/-0.2v**
Output Current:	**700mA max**
Charging Mode:	**cc/cv**
Chargeing Time:	**6 hours**
Operating Temperature:	**-10 ~ 45C**
Storage & Transp. Temp.:	**-20 ~ 45C**
Case Material:	**Aluminum**
Dimensions:	**100x62x13mm**
Weight:	**120g**
Cycle Life:	**500 cycles**
Fuel Gauge LED:	**5 level LED indicator**
Charging Indicator:	**All 5 LEDs are lit when fully charged. Leftmose LED flashes when charging is required**

Project Update



Future Work

- Order battery
- Order circuit components e.g diodes
- Continue experimenting with parts already purchased
- Continue to provide periodic progress reports to our advisors

Questions