ENSC 305W/440W Grading Rubric for Project Proposal

Criteria	Details	Marks
Introduction/Background	Introduces basic purpose of the project. Includes clear background for the project.	**/05%**
Scope/Risks/Benefits	Clearly outlines project scope. Details both potential risks involved in project and potential benefits flowing from it.	**/15%**
Market/Competition/ Research Rationale	Describes the market for a commercial project and details the current competition. For a research project, the need for the system or device is outlined and current solutions are detailed.	**/10%**
Company Details	Team has devised a creative company name, product name, and a logo. Outlines relevant skills/expertise of team members.	**/05%**
Project Planning	Details major processes and milestones of the project. Includes Gantt, Milestone, and/or PERT charts as necessary (MS Project).	**/10%**
Cost Considerations	Includes a realistic estimate of project costs. Includes potential funding sources. Allows for contingencies.	**/05%**
Conclusion/References	Summarizes project and motivates readers. Includes references for information from other sources.	**/10%**
Rhetorical Issues	Document is persuasive and could convince a potential investor to consider funding the project. Clearly considers audience expertise and interests.	**/10%**
Presentation/Organization	Document looks like a professional proposal. Ideas follow in a logical manner. Layout and design is attractive.	**/10%**
Format Issues	Includes letter of transmittal, title page, executive summary, table of contents, list of figures and tables, glossary, and references. Pages are numbered, figures and tables are introduced, headings are numbered, etc. References and citations are properly formatted.	**/10%**
Correctness/Style	Correct spelling, grammar, and punctuation. Style is clear concise, and coherent.	**/10%**
Comments		

September 23, 2013

Mr. Lakshman One
School of Engineering Science
Simon Fraser University
Burnaby, British Columbia
V5A 1S6

Re: ENSC 440 Project Proposal for Power-Generating Shoes

Dear Mr. One,

The attached document, our *Proposal for Power-Generating Shoes*, describes our project for ENSC 440(Capstone Engineering Science Project). Our goal is to design a pair of shoes that can generate power by walking to charge portable electronics devices. Our project makes use of the wasted energy from walking to generate electricity, which is green and can be further developed to increase the power efficiency.

The proposal provides introduction and background about energy, and then we come up with a conceptual system that can generate electric power from walking. We discuss possible design solutions and propose a solution with budget, funding, and schedule to complete the project. Additionally, the proposal provides information about our company's team members.

ePower Incorporated consist of 4 talented senior engineering students: Janine Li, Eric Yang, George Gu, and Edward Huang. If you have any questions about the project proposal or our company, please feel free to contact us by phone at 778-836-9730 or by email at jiayinl@sfu.ca.

Sincerely yours,

Janine Li
Chief Executive Officer
ePower Incorporated

Enclosure: Proposal for Power-Generating Shoes

Proposal for Power-Generating Shoes

Janine Li
Chief Executive Officer

Eric Yang
Chief Technical Officer

George Gu
Chief Operating Officer

Edward Huang
Chief Financial Officer

Contact Person: Janine Li
Jiayinl@sfu.ca

Submitted to: Mr. Lucky One – ENSC440
Mr. Michael Sjoerdsma – ENSC305
School of Engineering Science
Simon Fraser University

Issued Date: September 23, 2013

i. Executive Summary

Since the common resource such as oil, natural and coal are going to run out in the future, why don't we produce and store electric energy via their simple daily routines. ePower is proposing a product e-Shoe that satisfies specifications for self-generation of electric power.

Basically, e-Shoe can be considered as a device to produce electric power by walking. That means mechanical energy can be converted into electric power, and then the energy would be stored to a desired chargeable battery.

After doing some research, we came up with two possible design solutions, Faraday's Law of Induction and Piezoelectric transducers, then with team discussion, we successfully came down to one design solution which is to use Piezoelectric transducers. Our budget towards to this project is roughly around $105, and this value can be higher or lower depending on how this project goes in the future.

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List of Figures and Tables

1. Introduction

Do you think that you are a powerful person? We believe that no one would challenge how powerful the electricity is. Ever since electric power is discovered in the world, there are many great products that had been produced to help improve the quality human life style; as time goes by, both electric energy and those electronics products are easily achievable and affordable. However nothing is perfect and completely harmless, so are producing electricity energy. As the demand of the electricity energy is getting higher, there are many multiple energy exploitations that people are searching and trying to apply. “To make an energy fix, we need an energy mix” is one of slogans from the BP oil company [1]. A lot of commercial energy companies hope to offer much more resources, meanwhile people need some environmental and cheap power sources to retard the environmental pollution.

The World Coal Institute states that the most common resource such as oil, natural and coal will run out in 130 years at the current rate of consumption [1]. There are some alternative clean and long-term power sources such as solar and wind energy. However, the advantage of solar usage is familiar to our minds but not in our dwellings or our reality, since those configuration of solar absorption is not affordable for each family. If people can produce and store electric energy via their simple daily routines, we can use cheap resource and contribute to our environmental maintains. Thomas Edison(1931) said that he would invest long-term power resource but not until the current power source die[2]. ePower wants to improve our life style while trying to minimized those negative impacts to our planet, Earth. ePower is proposing a product e-Shoe that will satisfy specifications for self-generation of electric power. The e-Shoe can be considered as a device to produce electric power by walking. That means mechanical energy can be converted into electric power, and then the energy would be stored to a desired chargeable battery. The electric power stored in the battery can be transferred to other electric devices such as mobile phone or flashlights. This function offers a limitless power source and flexible charge to people. Are you a powerful person? Yes, you can be.

This proposal will present ePower’s design consideration for an e-Shoe pad feasibility with chargeable mobile phone battery. This proposal provides an overview of our design, possible solutions, budget analysis, team organization and expected design process.

2. System Overview

In our system, we have input of walking and output of electricity. When people are walking, they are generating mechanical energy. However, the mechanical energy created while walking is wasted. Therefore, we can convert the mechanical energy into electrical energy by using a mechanical-to-electrical converter, a “black box.” After applying an electric power management circuit in our system, we will have a stable 5V output from the output of the “black box.” Then we can store the energy through a USB cable to a rechargeable battery, which is fastened on our legs. The battery can further charge our portable devices such as cell phones, IPods, and GPS devices. Our product concept is illustrated in the following figure.

Figure 1: Product concept

The following flowchart shows how our system charges a battery.

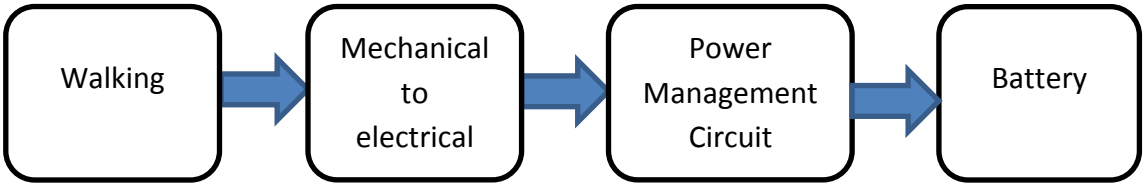

Figure 2: Flowchart of our system

3. The Design Functions

The most important function of our product is generating power to charge the portable devices. The user can switch the button to select either charging or non-charging. Then, if the product is not charging, the LED light is dim which means the product turns off. The LED light will turn red when the product is charging, and turn blue when the portable device has been fully charged.

Also, the product starts charging when the person is walking with the shoe pad. It is important to make the product rough enough to hold the person's weight with his/her carries. At the meantime, the product should be waterproof and weather resistant so that people can still use it even when it is raining or snowing.

4. Possible Design Solutions

After research, our team has come up with two ideas on what the mechanical to electrical converter would be and can be used for our project.

4.1 Faraday's Law of Induction

Applying Faraday's Law of induction, we can use gears to rotate a coil of wires with respect to a permanent magnet; therefore, we can generate electricity by changing the flux. The idea sounds very good. However, we are thinking to make our design as small as possible. When people are walking with our design, they will not feel anything different and feel like normal walking. In order to get a larger voltage at output, we have to make the size of coil bigger. Then, it is very hard to make it small enough to put it in shoes.

4.2 Piezoelectric Transducers

Using piezoelectric transducers, which will convert the force exerted on the transducers to electrical energy by piezoelectric effect. The reason we choose this idea is because the piezoelectric transducer is small, thin and cheap. After putting it in the shoes, the person will not feel anything. At the meantime, it can generate the power we need in output. Considering the market, the cost of piezoelectric transducer is low compared with other possible material.

5. Proposed Design Solution

As discussed in last section, our proposed solution is to design and build a shoe pad with piezoelectric transducers and power management circuit, and then the energy can be transferred to a battery with USB port that can be fastened on the legs. This kind of device can give a great benefit to the public, especially for the people who enjoy hiking. Moreover, the shoe pad is not shoe specific, which means it can be put into any kind of shoes with the same size. Nowadays, almost everyone bring portable devices with them. Keeping the devices powered is not always easy when people do not have a power source or charging cables. At the same time, generating electricity by walking is all natural resource and it is environment-friendly.

The main difficulties in completing this project are the limited time. We have only three months to complete the project, and only four team members in the group. Moreover, the uncertainty of energy output at a single step from e-Shoe is also hard to deal with. Then we have to add a power management circuit in the system to make it stable. Within these difficulties, we will be able to build an e-shoe for more certain functions and generate the electricity using piezoelectric transducers.

If we can have more time and people in our group, we would develop the e-shoe with more useful functions. For example, the e-shoe could count how many steps the user walks and the user can reset the counts by pressing the button.

6. Sources of Information

After we have decided the project idea, we have used and will be using several resources to complete our project.

Internet is one good source for our information we need, we can find out what components we need and their datasheets. We can also find other similar projects using piezoelectric and improve our design.

Textbooks will be a major source on our power management circuit design, and SFU professors and TAs will be another source to help us improve the circuit design.

7. Budget and Funding

7.1 Budget

The following table shows the tentative budget which will be used for research and development purposes.

Component	**Budget**
Piezoelectric Transducer	$10x4
Electric Components(Opamps, capacitors, resistors etc)	$25
Rechargeable Battery(USB port)	$20
Breadboard	$10
Shoe Pad	$2.5x2
Belt	$5
Total	**$105**

Table 1: estimated total cost for our prototype

This is only the estimated budget. The price information comes from different online retailers, and local retailers.

7.2 Funding

Since our group was too late to apply for ESSEF funding, we will apply for Wighton Fund, and if the funding is insufficient, the rest cost will be equally distributed among our group.

8. Schedule

8.1 Gantt chart

The following is the Gantt chart displaying the timeline for out project.

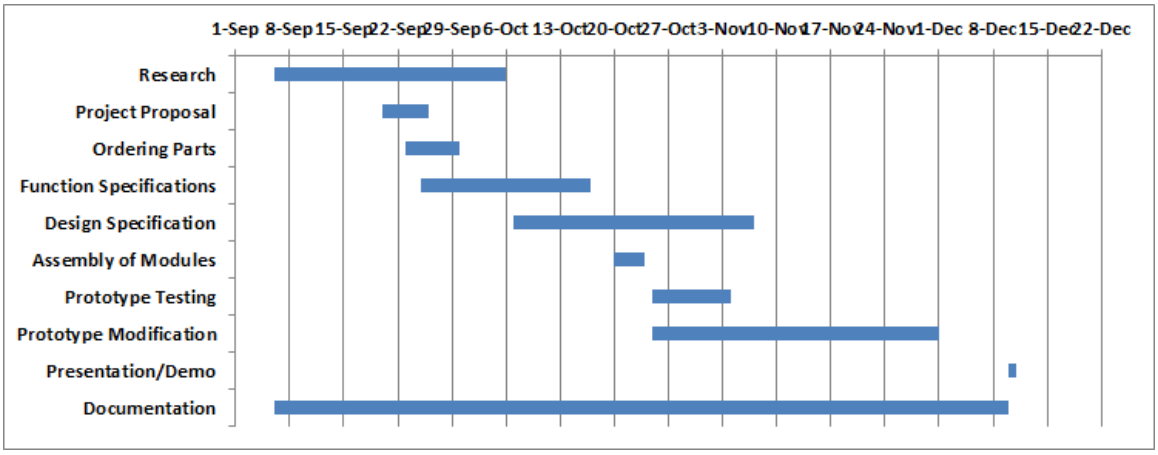

Figure 3: Gantt chart

8.2 Milestone chart

The following figure shows the milestones along the way the completing our project.

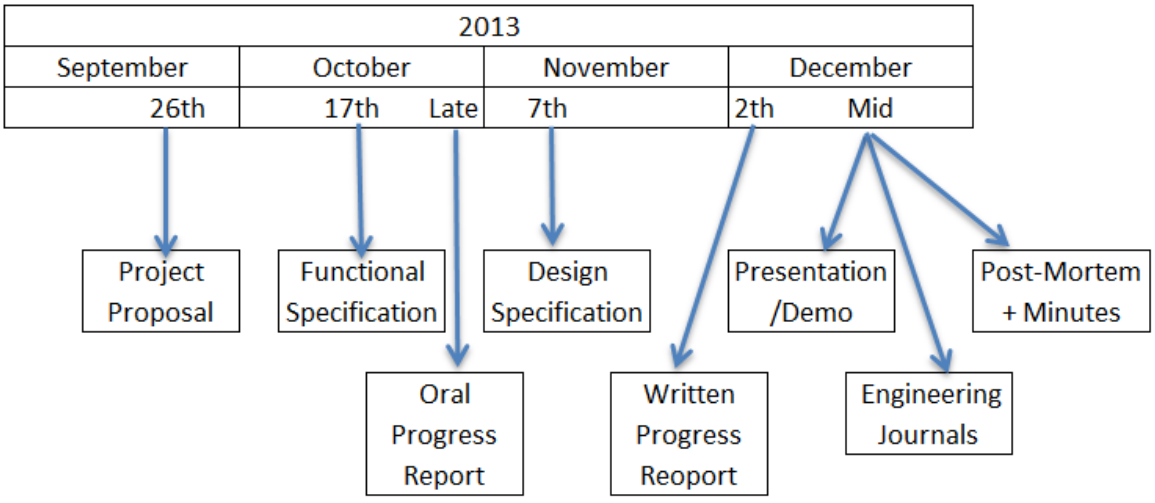

Figure 4: Milestone chart

9. Company Profile

Janine (Jia Yin) Li, Chief Executive Officer (CEO)

Janine is a fourth year Electronics Engineering student at Simon Fraser University. Over the past four years of education and the experience of being hardware designer in Research In Motion, Janine has developed strong communication skills during the completion of projects in school and in her coop job. Also Janine has built up her ability of circuit design and printed circuit board analysis. Moreover, Janine expands her network by helping to run her family business in her spare time.

Eric (Wen Lin) Yang, Chief Technical Officer (CTO)

Eric is a fourth year Electronics Engineering student at Simon Fraser University. During 4 years of studying at SFU, Eric has gained good knowledge on circuit design, and he had an 8 months coop experience working at Sierra Wireless as a hardware design coop. The valuable coop experience improves Eric's skills in circuit design, testing, and verification. Moreover, the teamwork and communication skills that Eric gained at Sierra will also contribute to the project and ePower.

George Gu, Chief Operation Officer (COO)

George is a fourth year System Engineering student at Simon Fraser University. He had an 8 months coop experience working at TELUS as an Outside Plant Engineering Coop. George has strong skills in control systems and circuit design. Also, his problem solving skills and passion will contribute to ePower.

Edward Huang, Chief Financial officer (CFO)

Edward is a fifth year Electronics Engineering students at Simon Fraser University. In the past five years at SFU, and four4months coop experience working in CTCI Corporation as Associate Engineer, Edward has learned strong hardware design, and developed good communication skills with team members. Edward also know how to use AutoCAD very well.

10. Conclusion

ePower Incorporated is currently developing e-Shoes for generating and storing electric power by walking. This product will fit into any different kinds of shoes, thus the user can still purchase the shoes they like and love to wear; the product will also not harm the user's feet, because it is just like the normal shoe-pad, except that there are piezoelectric transducers and a small PCB on the bottom. Therefore everyone can purchase and use it, which broadens our company's customer range. The most important thing is that our product will be extreme practical and useful to slow down the environmental pollution problem, since people are generating power themselves, and natural resource shortage problem will be eased. There is no similar product in the market yet, but we did find out that there are other groups are working on this kind of product: PediPower shoes [3], but they are using a different solution than ours, which is similar to our first possible solution discussed above. But we think that those shoes are too awkward to use in daily life, and they are shoes specific which makes the product to have a small market. We know that they can produce 400mW from their product, and we try to make our product to produce greater electric energy and to have a lower cost from our own design. Our company's goal is to save power sources and exploit a long-term and clean energy solution with simple and achievable action for most people.

e-Shoe is the first product of our company. We will keep improving its efficiency of generating electric power and developing more functionality, for instance, GPS function.

11. Reference

[1] D. Abbott, “Keeping the Energy Debate Clean: How Do We Supply the World’s Energy Needs?”, (IEEEXplore), [Online] 2010, http://ieeexplore.ieee.org.proxy.lib.sfu.ca/stamp/stamp.jsp?tp=&arnumber=5357584&tag=1 (Accessed: September 21, 2013)

[2] *J.Newton, Uncommon Friends: Life With Thomas Edison, Henry Ford, Harvey Firestone. Alexis Carrel, and Charles Lindbergh.* New York: Harcourt,1987.

[3] IndiaTimes, “Now, Shoes that Generate Electricity!” (indiatimes), [online] 2013, http://www.indiatimes.com/technology/science/now-shoes-that-generate-electricity-77941.html (Accessed: September 21, 2013)

