Elos- The Shoe Sole Reinvented

Jeremy Collins
Department of Mechanical Engineering

Andrew Crippen
Department of Electrical Engineering

Michael Rechtin
Department of Industrial Engineering

Tyler Tracy
Department of Computer Science

Mentor: Alexander Nelson, Ph.D.
Department of Computer Engineering

Abstract

People are not able to use their hands to interact with technology when their hands are full or preoccupied. This problem wastes the time of nearly every modern consumer. Our solution is *Elos, The Shoe Sole Reinvented*. *Elos* will allow users to perform relatively simple functions on their electronic device using their feet. These functions will be performed with actions which are similar to hand gestures used to control modern smartphones but using the feet instead. We intend for *Elos* to allow for greater efficiency when using devices by providing new interaction options to both tech-savvy individuals and the average consumer. Our product is a pair of removable shoe soles, containing a set of pressure sensors and accelerometers, allowing for a very detailed and precise range of foot motions.

1. Introduction

Tech savvy individuals, gamers, and disabled individuals have a challenging time interacting with their devices when their hands are full, busy, or otherwise unavailable. Modern culture provides productive individuals with "a need, or a motivation, to media multitask (to fit in everything they want to do), and the opportunity to media multitask" (Foehr, 2006), just to keep up with their daily tasks. This need is not properly fulfilled by existing devices. Mainstream input devices as of now can only be controlled by one's hands, therefore there are very few ways to interact with a device that are handless. Using this information, we have reinvented the shoe sole to address this problem.

1.1 Project Objectives

We would like to convince our market that the lack of handless interaction with devices is a problem and that Elos properly addresses that problem. To do this, extensive advertisement and market research is required. We would eventually like to compete with the likes of the Apple Watch.

1.2 Product Objectives

a. To create a shoe insole that allows the consumer to control their devices
b. To include two accelerometers and pressure sensors in this insole to capture movements
c. To allow to user to assign different functions for unique actions that they perform
d. To make this product in a way that does not hinder comfortability or movement

1.3 Project Constraints

- Power Consumption

The product will contain many pieces of technology like an accelerometer for detecting swipe actions, some sort of button for direct input, a Bluetooth transmitter to send actions to the device, and a microcontroller like a Raspberry Pi or Arduino to control everything. This will use a significant amount of energy. To address this, we will need to install lithium coin batteries or another type to hopefully make our product rechargeable.

- Size

Another goal for the product is for it to be modular, so it can fit into any shoe. This will make the size and dimensions of the product very constraining, because it will have to include all components plus charging tech and it cannot impede walking ability. Methods to get around this will be to put the battery, the Bluetooth transmitter, and the accelerometers into the sole.

- Durability of Current Technology

The product should be able to endure the constant force applied by the user's weight on the components of the device. This will limit our design, whether it be the size and capacity of the battery or the cost of the components.

1.4 Competition

Our product reaches a new realm of the market that has not been tapped into yet. Therefore, our competition involves products that partially satisfy our product's criteria.

SolePower SmartBoot
This is a boot that tracks workers and keeps them safe by having GPS and a sensor that detects if you have fallen or are fatigued and has lights on the front of the boot to reveal the ground in. This product is handless and charges itself, so no maintenance is required. Cost: $200 (Griggs 2015).

Levi's Commuter Trucker Jacket (Jacquard)
Jacquard is a system made by Google that allows touch sensitive technology to be woven into the fabric. This allows interaction with a cellular device by touching certain parts of the jacket. This is a huge strength, but it still requires the use of hands for interaction with the product. Currently, the only product to carry Jacquard in it is the Levi's Commuter Trucker Jacket. Cost: $350.

Instep NanoPower
This is a shoe that contains a proprietary fluid in the sole. The shoe uses the thermal differential between one's foot and the fluid to generate power to charge your devices. It does function as a handless charging device, but it does not work as a control peripheral. Cost: $60.99.

Bili Pro Foot Mouse
This product is a USB mouse to be placed on the foot with 6 programmable foot buttons on a board to be used by the other foot. Although this device is a peripheral and is handless, the product is extremely cumbersome, requiring the full use of both feet and an external source of power, and requires setup. Cost: $150.

2. Design

Our product is a multi-layered design, with the bottom layer being the power system consisting of 4 button batteries, a Bluetooth transmitter, and flexible printed circuit board acting as the control system, the second layer being a conductive shield, the third layer being a series of capacitive plate sensors, and the top layer being a gelatinous insulator (See Figure 2).

2.1 Component Details and Specifications

- Pressure sensor layer ($10): Used to measure weight distribution of the user for input gestures.
- Gel Layer ($5): Provides comfort and insulates the sensor from the foot
- Bluetooth ($10): Used to pair with any Bluetooth capable hardware
- MicroController ($5): Used to process input and control the electronics
- Battery ($15): These are used to power the device. 2000 milliamp hours
- Accelerometer ($3): Used to measure foot movement

2.2 Proof of Concept

As a proof of concept, a Wizard of Oz test was conducted, meaning that a prototype was presented to test participants and its functions were controlled from a separate computer giving them the illusion that they were given a working prototype. The reason this test was conducted was to overcome the greatest challenge to our product: being able to convince people that Elos is a product that they would use rather than just a gimmick. The test consists of four phases each with a unique purpose. In the main room there was a camera filming only the participants feet while the product was attached to their foot. In front of them there was a computer monitor that was being controlled by another person in the back room.

Phase 1:

Participants do the action displayed on the screen with their feet. The instructions are to move the foot correctly, incorrectly, and then correctly again. The screen will either right flash green (correct) or red (incorrect). The next action is displayed, and the process continues.

Phase 2:

Gestures will appear on the screen like the last time and then there will be more actions that controls the computer such as volume up and down that will fire once the gesture is completed. If done correctly, the screen turns green and the participant does the next gesture.

Phase 3:

This is the sandbox phase where the six gestures will be listed on the screen with all six actions and the participants will be given one minute to try all the actions and do them in any order they want.

Phase 4:

This is the final phase. The screen will show one action at a time like in phase one and participants will have to go through them all. This time there will be all the gestures not just six. They will go through them all just like the first time.

Post Test:

Participants are given a post survey where they provide constructive feedback on the testing process.

2.3 Post Survey Results

We did not receive IRB approval to perform this test before this paper was printed. Thus, we were not able to perform the experiment. Had we been able to perform it, the experiment would have shaped our design in the following ways. Firstly, it would have given us an idea of how obtrusive of an object people were going to allow in their shoe. Secondly, we would have been able to adapt the technology inside of the product to allow for new movements, that would have been suggested by participants.

2.4 Product Relevance

Unlike our competitors, our product provides a non-invasive, comfortable way of handlessly interacting with an electronic device. No other competitor has a method of handless interaction that is both functional and practical to use.

3. Market

Our market reaches a large audience that is engaged in social media. After interviewing potential users, we found out that the market is easy to deploy to because of the strong user participation within our advertising platform.

3.1 Potential Consumers

We will target tech savvy individuals (anybody who uses a computer often), gamers, and disabled individuals. If people possess a more efficient way to interact with their devices, use time will be cut and people will get work done faster by using their hands and their feet at the same time. Also, those with carpal tunnel or other hand/arm injuries or disabilities often can't use a computer without voice activation or motion sensing. A shoe device could turn on the computer and give them a way to interact with it without using their hands.

3.2 Market Interview Results

After receiving responses from over 45 people, most were open to the idea of having a new way to interact with their technology. However, their mouse and keyboard setup seemed to be satisfactory for them in addition to being skeptical about a new input device would be put into their shoe. But, most people did have the problems that we identified with existing technology. Dirty hands, VR, gaming inputs, cooking, lab use, and playing music were all shown to be uses that people would use a foot peripheral for. Additionally, consumers were willing to pay at least 50$ for such a product.

3.3 Perceived User Value

Based on our market interview results, ease of use, battery life, size, style, and removability are the primary factors people look for in our market. The weight of each value can be seen in Table 1. Then, by plotting price against the Perceived User Value, we found which market segment we are in as well as how well we might hypothetically perform against our competition in Figure 1. Compared to our competition, our price is extremely low, but with a high perceived user value, meaning that we will be operating in the first quadrant. Removability is what sets our product apart. The ability to be removed from the shoe is both valued by consumers and unique to our product.

3.4 Costs and Profit

We believe that our product will cost roughly $20 to make. Our market research tells us that people would be willing to pay $50-$100 for a product like ours. Thus, we intend to charge $75 for our product. This will give us $55 of profit for every product sold, or a profit margin of 73.3%.

3.5 Marketing and Sales Channel

As our product appeals largely to a younger audience, we cannot rely on more conventional methods of advertisement. We want to advertise our product online, mainly through social media such as YouTube and Instagram. We would like to give free trials of our product to large YouTubers and online personalities in order to prove to our audience that the product is viable and solves a problem. We also would like to sell our product online either independently or through an online retailer such as Amazon.

4. Business Plan

At this point in time, we do not believe that Elos is a viable product. We believe that the large market that we are trying to appeal to might not yet be ready for this type of product, so another course of action could be to try and receive investment from local companies such as Tyson, J.B. Hunt, and Walmart. There are many areas that each of these companies could use our product such as cooking, in the deli, efficiency improvement, and more. Before we go to these companies though, we will be seeking patents that can protect our innovative product from being copied.

5. Conclusion

Elos is a multi-layered shoe insole that connects your feet to your everyday life. By using sensors and foot inputs, Elos can control a computer, smart phone, or even a tablet. Although we were not able to make a working prototype due to time constraints, our design can be constructed very easily with the right equipment. We believe that one day, every part of our bodies will be connected and Elos is a big step towards doing that. There is not one product on the market that is comparable to ours let alone at the price of $50-$100. Others should continue to invest in this product, but as of now, our group will instead be focusing on our college work.

6. Tables and Figures

Storage		SmartBoot		Jacquard		NanoPower		Bili Pro		Our Product	
	Weight	Rating	RxW	Rating	RxW	Rating	RxW	Rating	RxW	Rating	RxW
Ease of Use	42%	7	2.94	8	3.36	6	2.52	5	2.1	8	3.36
Battery Life	26%	9	2.34	9	2.34	9	2.34	10	2.6	5	1.3
Size	16%	3	0.48	5	0.8	4	0.64	1	0.16	9	1.44
Style	9%	3	0.27	9	0.81	2	0.18	1	0.09	5	0.45
Removability	7%	0	0	0	0	0	0	10	0.7	10	0.7
PuV	100%		6.03		7.31		5.68		5.65		7.25
Price*		$	200.00	$	350.00	$	60.99	$	149.99	$	75.00

Table 1. Calculating the Perceived User Value

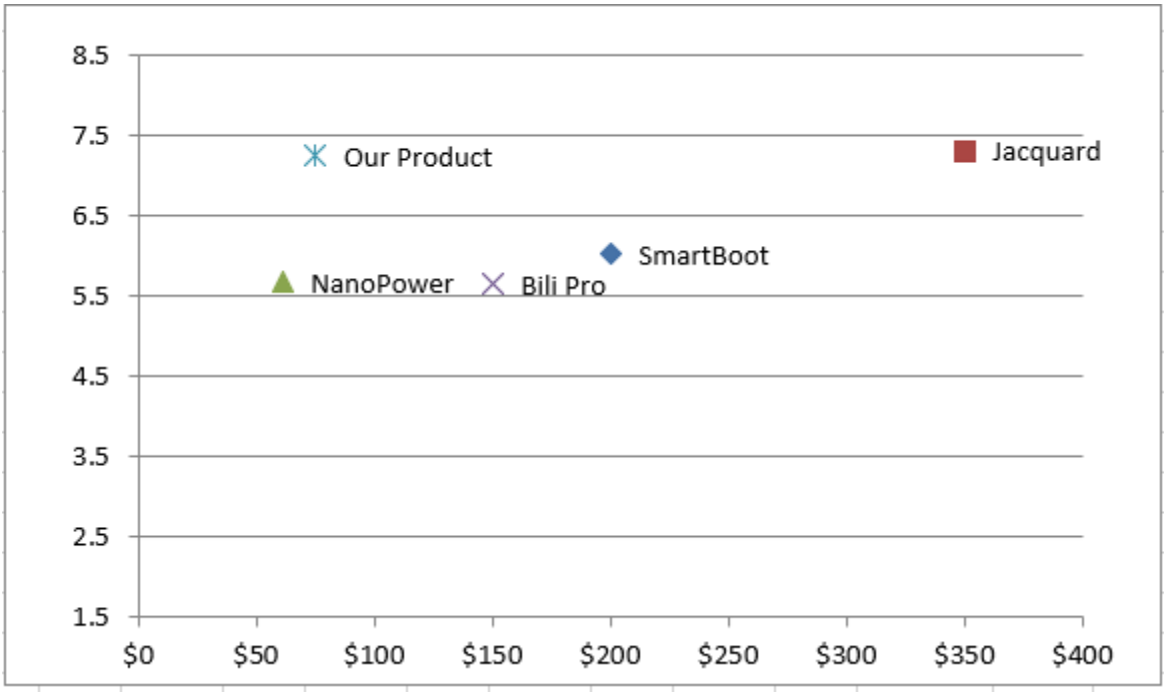

Figure 1. Plotting the PUV against Price

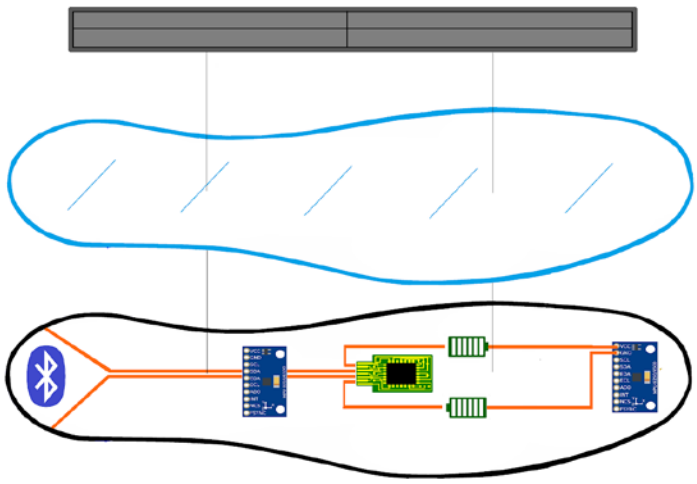

Figure 2. Design

7. References

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