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January 22, 2007

Lakshman One
School of Engineering Science
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Re: ENSC 440 Project Proposal

Dear Dr. One:

The attached document, *Proposal for a Handheld Computer Pointing Device*, outlines our project for ENSC 440. Our goal is to design and develop a handheld computer pointing device that does not rely on a flat surface that traditional mice require, typically in situations where such surfaces are not available.

The objective of this proposal is to present a problem and possible solutions, and then follow-up with a general impression of the selected design and its features, its budget and sources of funding, and our projected timeline of development. Finally, this document will discuss the product's place in the market, and acquaint the reader with the company behind the product and its employees.

Pointex consists of 5 motivated and dedicated senior SFU Engineering Science students: Frank Chen, Donavan Ho Sui, Randall Lim, Jeff Wong, and Kevin Yang. We can be contacted by e-mail at *ensc440-group-16@sfu.ca*.

Sincerely,

Frank Chen
CEO
Pointex

Enclosure: *Proposal for a Handheld Computer Pointing Device*

Proposal for a Handheld Computer Pointing Device

Project Team:
Frank Chen
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Submitted to:
Dr. Lakshman One – ENSC 440
Steve Whitmore – ENSC 305
School of Engineering Science
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Executive Summary

Sitting at base camp on Mt. Everest, Joey booted up his laptop so he can record the day's climb progress. He plugged in his mouse, only to realize that there was no proper surface to use it on. He reached into his bag once more hoping for his mouse pad. No success, as he neglected to pack it. Without a proper place to use his mouse, he has no hope of easily navigating around his computer.

The above scenario occurs more often than most people think. It does not limit itself to mountaineers, but also geologists, field biologists, and generally people doing their jobs in the field. According to a report[1] published for the Association for Computing Machinery's 1999 Computer-Human Interaction (CHI) Conference, people working on laptops with an external mouse are more than twice as productive, 48% to 58% faster, and made 42% to 53% fewer errors than those working with the laptop's built-in touchpad or trackpoint. Unfortunately, while working in the field, the flat surfaces that are required for mice to work properly are rarely readily available. As a consequence, productivity suffers.

Our objective is to develop a handheld wireless pointing device that will work in the only available space left: the air. Much like the simulated light pistols in video games, our device will navigate the mouse pointer by simply pointing at the desired location on screen. Older screen pointing technology relies on timing the electron gun scans characteristic of tube displays. Consequently, it only works with CRT monitors. By using infrared positioning technology, our device will work with all types of displays. Moreover, such a device will allow a more interactive environment when playing games.

The team consists of five fourth-year SFU Engineering Science students with varying backgrounds and experiences in digital/analog electronics, software and firmware design, and wireless technologies.

The project is forecasted to be completed in a span of 13 weeks until roughly mid-April where we will have a working prototype. The budget is expected to be approximately $320 with no outside sources of funding to realize the first working prototype.

[1] "Performance Evaluation of Input Devices in Trajectory-based Tasks: An Application of the Steering Law", Accot, Johnny and Shumin Zhai (1999)

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1. Introduction

Studies have shown that people working on laptops with an external mouse are much more productive, faster, and accurate than those working with the laptop's built-in touchpad or trackpoint. Unfortunately for people working in a predominantly outdoor field environment, such as geologists and biologists, flat surfaces required by mice are not readily available.

The objective of our project is to develop an alternative pointing device, SmartPoint, that these people can use without having to resort to their built-in pointing devices and compromise their productivity. The general idea is a handheld device that navigates the mouse cursor around the screen by pointing the device at the same location, much like video game light pistols.

In addition to workplace benefits, SmartPoint can also augment the computer gaming experience by providing a more immersive way of interacting with the game. Instead of using the traditional mouse to control the movements of an onscreen weapon, the user can experience the simulated sensation of holding an actual gun while pointing at the objects on the screen.

This document provides an overview of SmartPoint, including design considerations, budget and financial considerations, and projected timeline and milestone scheduling.

2. Possible Design Solutions

Trackball

A trackball mouse is an alternative to the conventional optical mouse. It utilizes a spherical ball (usually red) as the moving part and a stationary laser to detect displacement. It requires you use your thumb to move the ball, as you move the ball in a direction, the cursor moves in the respective direction. This product solves the problem of limited desk space that would usually limit a conventional mouse, however, the use of this product is unintuitive to some and requires a learning curve.

Trackpoint

A Trackpoint is the small button (also commonly red) found on older laptops to replace the need for a mouse on laptops. As you apply pressure to the Trackpoint in a certain direction, the mouse would move in that respective direction and display the mouse position on the monitor. A major issue with the Trackpoint is since it cannot detect a wide range for the rate of movement, the mouse would appear to move always at a constant speed. Therefore, if you want to move your mouse from one end of the monitor to the other, you would apply pressure for duration of time, making it inefficient. Also, since the button placement was implemented in between the keys of the laptop keyboard, access and usage of the Trackpoint often required two hands to use the “left click”, “right click”, and “drag and drop” functions, again presenting another case of inefficiency.

Touchpad

A possible design solution for an alternative to the mouse and Trackpoint is the laptop Touchpad. As you move your finger around the Touchpad, the mouse would track your movements and display the corresponding movements on the monitor. The Touchpad provided a design solution to having to carry a portable mouse and the laptop Trackpoint mouse button. The Touchpad requires technology to sense the touch of a human, and then track this movement over the range of the pad. The size of the Touchpad is often very small, therefore in the case of moving from one end of the monitor to the other, would require a repeated motion to sufficiently move the cursor’s position. Also, the technology used could not sense the touch of a pen, or other pointing utility, which limited its convenience.

Tablet PC

A Tablet PC is a laptop computer with a touch-screen and a keyboard. To move and select items only requires the user touch and drag over the screen; there is virtually no need for a mouse. This function is exclusive only to these expensive Tablet PCs, therefore limiting this costly function.

3. Proposed Design Solution

Our proposed design solution is to build a pointing device which uses infrared technology that will replace the mouse for computers. This pointing device would be extremely handy when the work space is limited. In addition, the device is intuitive and at the same time it can increase the user's gaming experience. The SmartPoint implements the following features:

- Intuitive pointing device
- Does not require a space limitation to operate
- Works as a regular mouse
- Wireless or wired pointer

A pointing device for PC is not a new idea. There are several pointing devices already in the market such as a mouse, touchpad, trackball and trackpoint. Unfortunately, these products require room to operate and/or are unintuitive. Our product offers a very intuitive design and it requires no desk space to operate the device.

The main constraint in the completion of this product is the amount of time available. We are given thirteen weeks to complete the product. In the given time period, we have to do research, design, development, integration and testing. Another constraint is the funding of the project. Since only thirteen weeks are allocated, we do not have much time to seek for funding. Unfortunately, this will limit us to put less focus on the enclosure of this product.

Given more time and resources, we can develop a much better device that is more versatile with more features that will be more appealing to the potential users. Such features include extended range of use, no line of sight limitation, and special kits for artists and designers. Furthermore, we would like to have a variety of focus groups to determine the effectiveness of our device in hopes of improving its performance.

Although we intend to design SmartPoint in such a way that we can compete in the PC pointing device market with a potential of future expansion in the gaming industry, for the purpose of ENSC440, we have decided to design SmartPoint specifically to replace the mouse.

4. System Overview

The figure below gives the overview of how the SmartPoint works. Unlike the traditional or even the optical mouse, the user has the freedom to relax and lean away from the computer screen while still having control of the mouse. This device conserves the user's workspace and it would prove to be really handy when space is limited around the computer. A perfect example of space limitation would be using a laptop on an airplane. The user simply moves and points the SmartPoint on the screen and the cursor on the computer would move according to the location of the pointer.

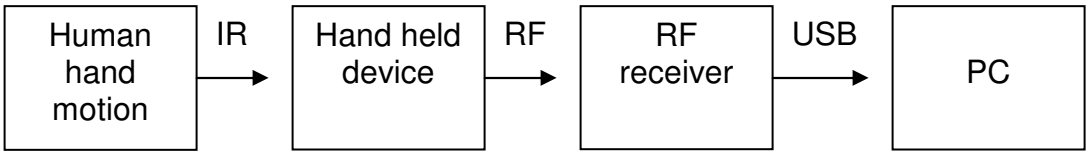

Figure 1 – Dataflow flowchart from SmartPoint to the PC

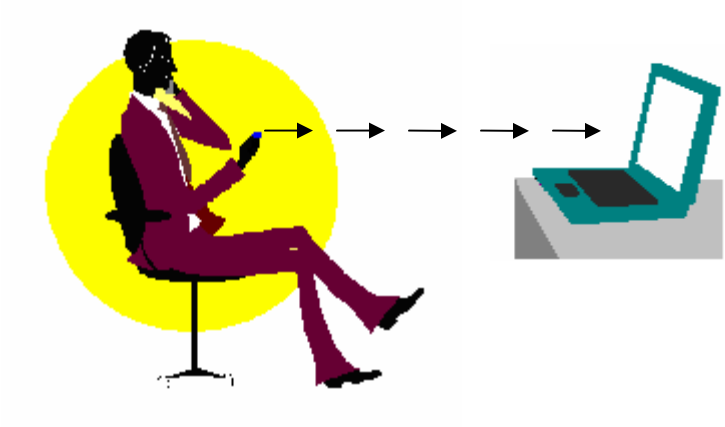

Figure 2 – Image Illustration of how SmartPoint works

5. Budget

The quantity and type of parts are estimated after having researched the necessary components required to build the project. To ensure that we do not encounter cost overruns, a cash reserve of $100 is considered as part of the total cost.

Hardware Parts	**Predicted Cost**
Contingency Cash	$100
PIC Microprocessor	$50
2 x RF transceiver	$40
Passive components (such as capacitors, diodes, etc)	$30
Case plastics, solder, glue	$25
Rechargeable battery (Li-ion)	$15
Infrared Emitter and Detector	$5
USB Type A Plug	$5
Total Cost	**$320**

Table 1 – Product costs

6. Funding

The overall cost of all hardware components can be afforded by sharing the costs between the project team. The amount invested from each member would be roughly $65 and is not of a substantial amount. This cost would cover the hardware to build our first prototype. The estimated cost does not include parts for creating an engineering prototype. Once we have created a working prototype, we will apply for funding from ESSS and also from company sponsors to subsidize our project so that we can take our working prototype further by creating an engineering prototype.

7. Project Timeline

Figure 2 and 3 outline our projected timeline and time allocation for the various tasks related to the project. We hope to have a working prototype and relevant documentation ready by April 6, 2007.

7.1 - Gantt chart

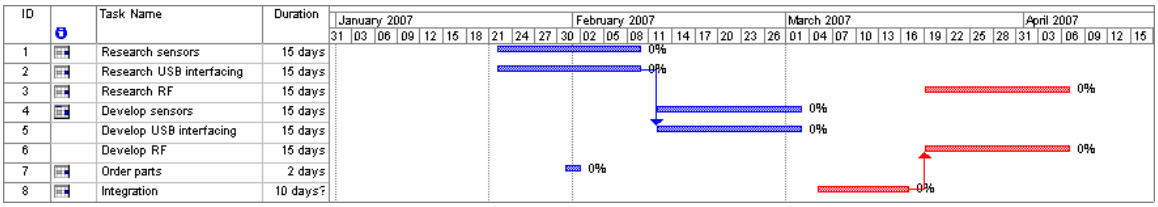

Figure 3 – Gantt chart

7.2 – Milestone chart

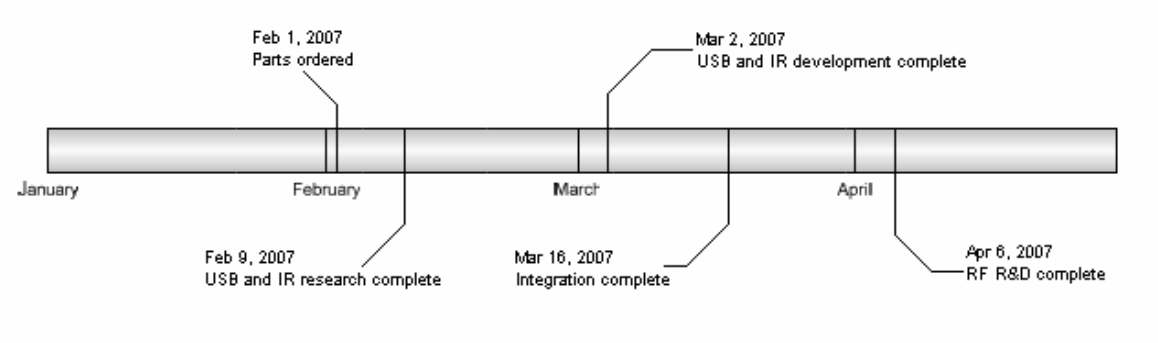

Figure 4 – Milestone chart

8. Company Profile

8.1 - Frank Chen – Chief Executive Officer (CEO)

Frank is a fourth year Electronics Engineering student at Simon Fraser University. Frank has previously worked at HSBC development centre as a technical assistant providing LAN and Lotus Notes support for over 500 users. Past projects he has completed include building a simple radio receiver, Butterworth filters and a homemade Semiconductor Parameter Analyzer (SPA) as well as some digital circuit programming in VHDL. He also has experience in embedded system programming using Assembly, PLC and QNX. In addition, Frank is familiar with MATLAB, Pspice, AutoCAD and other various software programs. Frank has excellent communication and organization skills and works well independently and in groups.

8.2 - Kevin Yang – Chief Operations Officer (COO)

Kevin is a fourth year Electronics Engineering student at Simon Fraser University. He has completed work terms at both Adex Electronics as a webpage designer and Electronic Arts as quality assurance. His strength includes hardware design, Pspice, MATLAB, VHDL, C/C++ and assembly language. His passion for electronics and hands-on project motivates him to excel in his projects. On his leisure time, he enjoys working out, playing basketball and reading about latest electronic gadgets.

8.3 - Randall Lim – Chief Financial Officer (CFO)

Randall is a fourth year Systems Engineering student at Simon Fraser University. As CFO, he is in charge of allocating the finances to separate parts of the project and ensuring that the project costs does not escalate out of control. He has had previous software co-op experience in VTech Telecommunications Ltd. working with instrument automations. He is also familiar with software programming using VHDL, Assembly, PLC, and has used C and Java to communicate between hardware components. He has experience from previous co-op work in working with PIC microcontrollers. Furthermore, Randall is currently pursuing a minor in Business and is familiar with project management and also handling the financial aspects of the project.

8.4 - Jeff Wong – Chief Firmware Engineer (CFE)

Jeff is a fourth year Engineering Science student from Simon Fraser University, majoring in Systems Engineering. As CFE, he is responsible for ensuring the embedded software is in working order. In his academics, he is well versed in software languages such as C/C++, Java, Visual Basic, VHDL, and the assembly languages for various microprocessors. In addition to software, Jeff is experienced in analog/digital circuit design and analysis, basic mechanical design and drafting, electromechanical sensors and actuators, and MATLAB simulations.

8.5 - Donavan Ho Sui – Chief Hardware Engineer (CHE)

Donavan is a fourth year Electronics Engineering student from Simon Fraser University with strengths in electronic circuits and hardware systems. He has an understanding of the principles and processes involved in designing analog circuits and circuit elements allowing him to be proficient in circuit analysis and hardware debugging. He also has experience with the circuitry simulation software Pspice, MATLAB, and high frequency electronics, which briefly include transmission lines and waveguides, microwave devices, traveling wave devices, the circuitry simulation software Pspice

9. Conclusion

Pointex is developing a specialized computer input pointing device to operate in place of the conventional mouse. The result of our goal is to take the PC input device to another level. Along with ignoring the limitations of desk space, we provide a more intuitive and easier method of communication with virtually any computer.

Our proposed input device would enhance everyday computer users in their interaction with computers. Our approach is more intuitive than competing existent systems through the use of sensors which can determine position and motion of the user's hand. Our system is functionally superior to conventional PC pointing device due to the independent requirement of desk space.

SmartPoint works magnificently in confined areas and in space limited environments. With the wireless functionality of our product, users will have the luxury of leaning back and relaxing while operating the computer.

10. Sources of Information

In research and development, we will obtain information from a variety of sources such as engineering textbooks, and manufacturers' component specification sheets for USB and sensor systems, however, we will most likely analyze our systems through our own research and testing.

The Internet will likely be a valuable resource for information for finding technical information, solutions to some of our problems, and for locating general information regarding our project. For example, we could research how USB ports operate and communication with computers occurs.

In addition, several faculty members at SFU have knowledge of data transmission and will most likely be able to guide us as to how to solve a particular problem. As well, some undergraduate students in Engineering Science have previously worked on related projects and can be contacted for technical information. For example, Harry Chen conducted a student-level USB research for their USB input device.

11. References

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