September 23rd, 2010

Dr. Andrew Rawicz,
School of Engineering Science
Simon Fraser University
Burnaby, British Columbia
V5A 1S6

RE: ENSC 440 Project Proposal for Braille Embosser

Dear Dr. Rawicz,

With passion and commitment, the four engineers in Sense Solutions are devoted to creating a practical, affordable Braille embosser for the visually impaired. Our product will give people a chance to own a personal Braille embosser at a minimum cost for everyday use.

This proposal includes overviews of the whole design, introduction and discussion of the technology and implementation, sources of funding, resources of information, our team organization and scheduled work distribution. We also provide analysis and comparison of possible solutions, detailed budget explanation and approximate time lines.

Sense Solutions consists of four innovative and skilled engineers who have various valuable backgrounds. All of us feel obliged to apply our knowledge and experience to develop products that will not only be useful and competitive, but also will benefit the society as a whole. We are Brendan Fairs (CEO), Yiran Du (COO), Heedong Park (CFO) and Rio Li (CTO). If you have any questions or concerns, please feel free to contact us at ensc440-sensesolutions@sfu.ca.

Sincerely,

Brendan Fairs
Sense Solutions, Chief Executive Officer

Enclosure: Proposal for Cost Effective Braille Embossing Device

Elementium

Proposal for a Low-Cost Personal Braille Embosser

Management Team:	Yiran Du Brendan Fairs Rio Li Heedong Park
Contact:	ensc440-sensesolutions@sfu.ca
Submitted To:	Dr. Andrew Rawicz - ENSC 440 Mr. Mike Sjoerdsma - ENSC 305 School of Engineering Science Simon Fraser University
Issued Date:	September 23, 2010
Revision:	1.0

Executive Summary

Owning a Braille embosser is a great luxury for any visually impaired person, as it can serve to help make their lives so much easier. With such technology, they can conveniently tell the difference between objects that have similar shapes and sizes (such as CDs) by printing out the names and marking them; they can write things down to remind themselves or write to their visually impaired friends. The need for Braille embossers is especially urgent for the people who are learning to read Braille since they require lots of practice.

Currently, a Braille embosser for personal and small business usage can cost from $1800~$5000 with selections of different features and functions. A Braille embosser will not benefit anyone if its price is far above the budget of its potential customers, even if it has a nice look and advanced features. Although Braille embossers have been on the market for a long time, the percentage of those visually impaired people who have access to the technology is still relatively small. People are in need for a solution that is truly affordable.

Sense Solutions is devoted to developing a practical, inexpensive Braille embosser that focuses on basic functions. With an embosser such as our *Elementium*, more and more people can learn to use Braille materials, helping to improve their way of life.

Sense Solutions consists of four highly innovative engineers with various technical backgrounds. All of us are well trained with skills that are required for implementing this challenging project and we have the confidence that a marketable product will be developed as planned.

The proposed design life cycle of this project including research, design, and implementation will be 13 weeks, with December 2nd 2010 as the scheduled completion date for a functional prototype. The entire project is tentatively budgeted at $440.00, which is expected to come from a variety of sources.

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1.0 Introduction

Statistics show that approximately 594,000 Canadians adults are experiencing vision impairment; this represents 2% of the adult population. Among the 290,810 non-senior adults, only 32% of these people are employed. [1] People with vision impairment have on average lower income than people with other disabilities, and they have on average substantially lower income than people with no disabilities.

Visually impaired people rely on Braille embossers for many different reasons, so they often need to have access to one. Currently on the market, however, a personal Braille embosser can cost them anywhere from $1800 to $5000 [2], which makes it impractical for them to own such a tool. Most visually impaired must go to special schools or stores to use Braille embossers that are open to the public, which can be very inconvenient.

Sense Solutions presents a viable way of solving the problem by introducing its new Braille embosser. This embosser is practical, functional and most importantly - affordable. The embosser is designed for everyday use and customers don't have to spend their money on any feature that is not essential. The *Elementium* will consist of several parts, including; user-friendly software that translates English into Braille automatically; a cable that transmits data between the computer and the embosser; and the embosser itself. Currently, a normal printer deals only with plain text. With our product, users can type text into the software, and by hitting the 'print' button, the software will complete conversion and send all the information to the embosser where corresponding material in Braille will be printed out.

The *Elementium* is convenient and effective. It will be the most inexpensive Braille embosser ever built anywhere in the global market. It is ideal for anybody who needs a simple, easy to use Braille embosser.

This document includes analysis and discussion of the technology, design overviews, sources of funding, information resources, and project scheduling. In addition, different possible solutions and our proposed solution are explained and evaluated. Also, the detailed budget and tentative time lines are included for references.

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2.0 System Overview

The Braille printing device will interface directly with a PC via a USB connector. A customized software program installed on the PC will perform three unique tasks to pre-process digital text and translate it into Braille codes. The processed data will then be transferred to the device memory, and then a microcontroller unit embedded with customized programming on board will manage timing and actuator firing sequence. Figure 1 shows the basic functions of the Braille printing device.

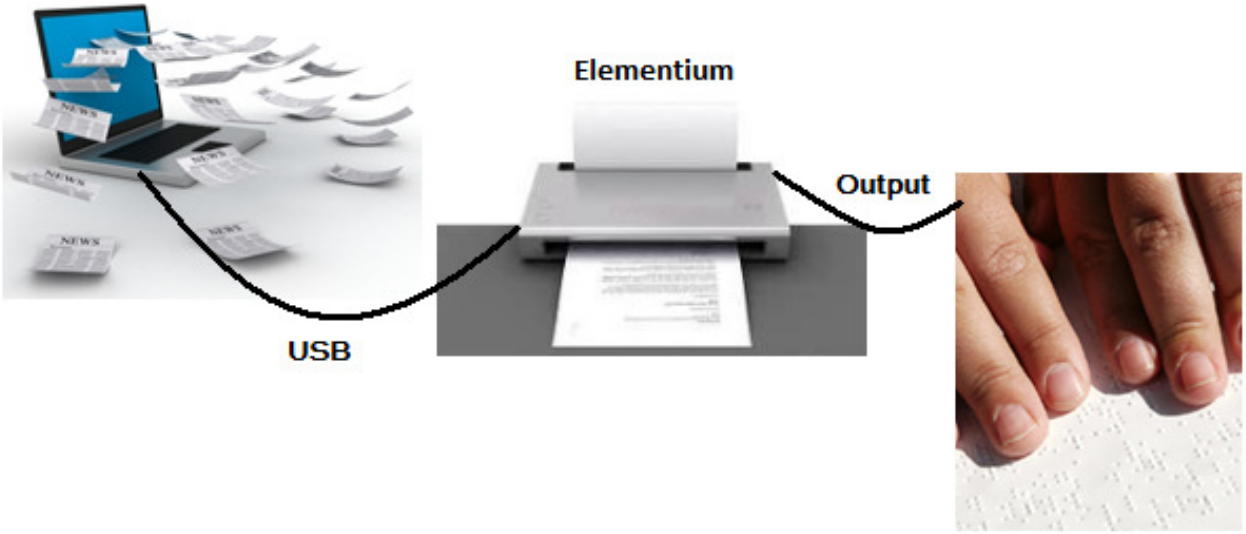

Figure 1: Conceptual Overview

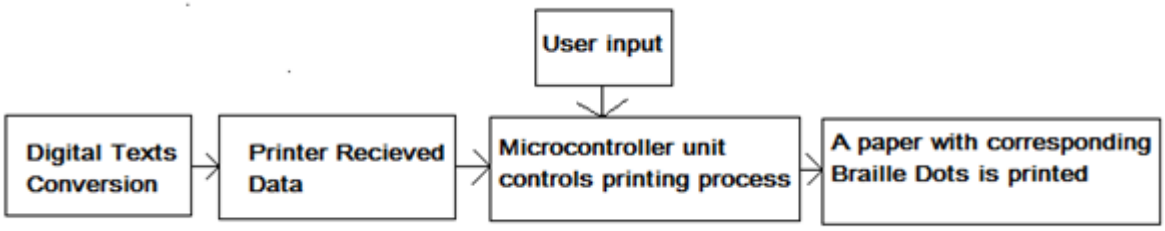

Figure 2: System Block Diagram

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3.0 Possible Design Solutions

Braille embossers receive data from computer devices and emboss that information in Braille onto paper through the use of solenoids that control embossing pins. With current technology, we are able to produce Braille by using different types of embossers. However, one problem that must be put into consideration is its cost-efficiency. In the present market, a small volume Braille embosser costs between $1800 and $5000. [3] Some of the embossing methods currently used are listed below.

3.1 Die stamping method

The die stamping method is the earliest used in Braille embossing. Firstly, it requires a specified typewriter to make concave dots on a Double Layer Metal sheet in order to create the Braille embossing pattern. A piece of heavyweight paper is then placed between the two metal sheets. By applying heat and high pressure to the Braille embossing pattern, the different combinations of convex dots are transferred to the heavyweight paper. However, this method requires a strict restraint for the heavyweight paper. Usually, the heavyweight paper used in this is over 120g. [3]

3.2 Ink printing method

Compared to the first method, the ink printing method is much better. Printing ink for Braille is made up of combining Rosin modified phenolic resin and general printing ink. By using Letterpress printing or screen printing technique, the Braille dots are printed on to the heavyweight letter. After a baking/heating process, the Braille dots will uplift and the Braille product is done. The Braille product can be embossed with relative ease and higher efficiency by using this method over the die stamping method. [3]

4.0 Proposed Design Solution

Our objective for this project is to design and implement a device that will print Braille dots on a paper that are pre-processed on a personal computer in cost efficient way. To carry the cost efficient theme, we will try to minimize hardware components that will be used to manufacture the device. Hence, the conversion software installed on a personal computer will perform three tasks to pre-process digital texts to reduce hardware processing. First, the software will receive digital text contents from the user. Then, the software will remove any unnecessary or unacceptable characters and then perform line parsing. Finally, it will convert the pre-processed texts to Braille points and fit them in a matrix frame as discrete binomial numbers.

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The data will then transfer to the device memory accompanied in a microcontroller interface. The microcontroller unit embedded with firmware and customized programming will manage the sequence of operations. It will control servo motors and manage timing with an internal clock to position an inserted sheet of paper. It will also access the memory to read a line of points, then fire electric signals to corresponding actuators through a programmable logic array network. The paper is on a pressure absorbing surface to prevent forming a puncture. This way common inkjet print paper can be used, keeping costs down.

Actuators of this design use pager motors which draw small current only. They will form a single line instead of 2 by 3 matrix of cell commonly used for current Braille printer in market. The cell of actuators with a line of characters will increase cost substantially; therefore, we decided actuators form a line of Braille dots instead of the cell formation. So, the device requires the pre-process software on personal computer as outlined previously.

The microcontroller unit will also manage user inputs using interrupt request and reset functions readily available with the microcontroller.

5.0 Sources of Information

Sense Solutions will gather information from many possible resources to acquire the necessary knowledge and comprehension to develop a complete low cost Braille embosser.

For the technical aspects of the design, Dr. Andrew Rawicz has expressed his interest in this project and he can provide valuable advice and technical knowledge. Also, Patrick Leung, P.Eng or Dr. Craig Scratchley can also provide technical feedback in microcontroller and conversion programming. Further, we may also need Dr. Ash Parameswaran for his expertise in electronics design and Ali Ostadfar, Ph.D student for his expertise in mechanical design for our project. Also, engineering journals and papers related to Braille embossing methods or similar applications will be valuable sources of information.

For the user interface aspect, we plan to interview a few people from Canadian National Institute of the Blind to acquire a better understanding on how visually impaired people read Braille and also gain better knowledge of cost and effort in printing contents of interest. By doing this, we can determine their needs and design the device effectively. We believe that journals and papers related to the use of the Braille for visually impaired people will also be helpful.

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6.0 Budget and Funding

6.1 Budget

Table 1 outlines a tentative budget for the cost effective Braille embosser. All estimated costs are determined under considerable research with specific models of components and they have been over-estimated by at least 15% for contingency. We also included miscellaneous costs into our budget plan to accommodate for additional components we may require for testing and to take into account shipping and tax charges. [4]

Equipment	Estimated Cost
Motors (Servo, Pager)	$90
Microcontroller Interface, Firmware + Programming Board	$120
CPLD	$40
USB Cable	$15
Power Supply Unit (Board)	$15
Pressure Absorb Material	$10
Miscellaneous Electronics & Test Components	$60
Mechanical Components	$20
Case	$20
Shipping + Tax	$50
Total	$440

Table 1: Estimated Budget for Prototype Device

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6.2 Sources of Funding

Our objective for this project is to design a Braille embosser with cost efficiency such that the price of the device is affordable to any individual. However, the initial prototype of this device is expected to cost significantly more than the cost of the final product for manufacture.

We are actively pursuing funding from the Wighton Engineering Development Fund. The fund source favors projects that provide benefit to our society especially for the disabled and elders. [5] Our device will allow visually impaired people to have more access to rich content available in digital contexts through computers.

In case we cannot raise enough original capital, we are willing to share the extraneous costs equally among the group members. All receipts and invoices will be kept and an accurate account of funds spent will be kept track of to ensure proper reimbursement and distribution of costs.

We also plan to contact professors for their help that allow us to use equipment we may need for our prototype device (i.e. FPGA program board).

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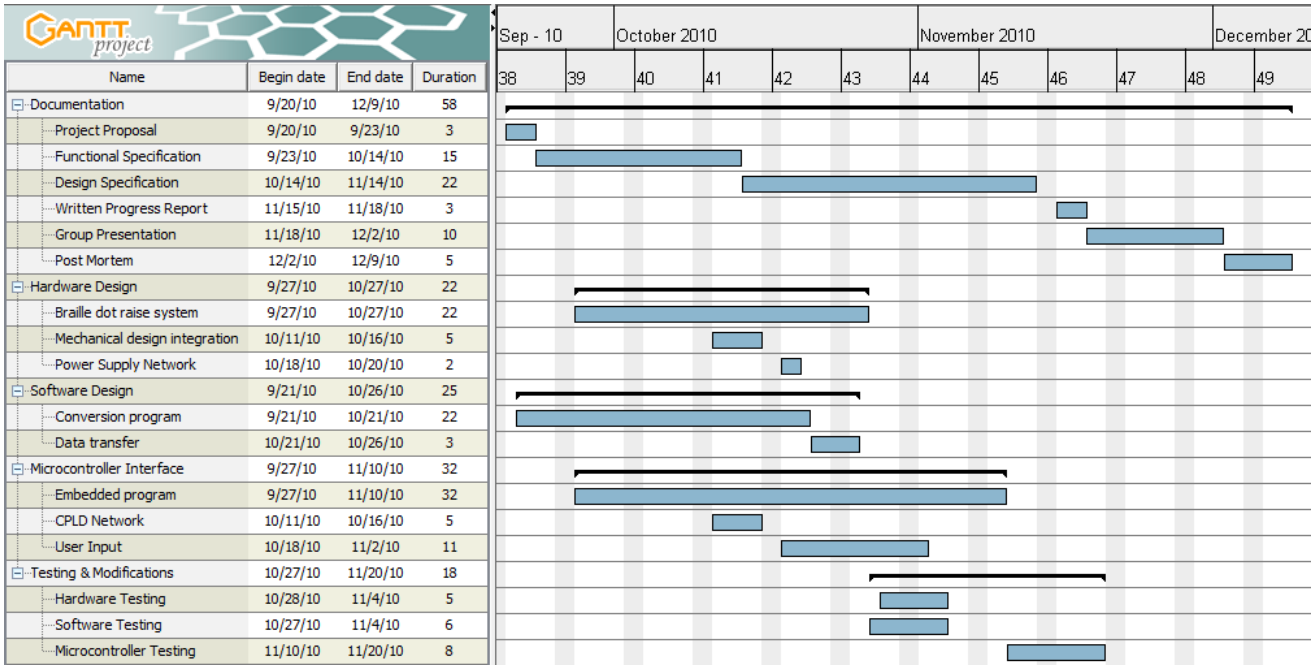
7.0 Schedule

The figure below shows the proposed schedule and estimated timeline as a Gantt chart representation. We plan to designate alternating positions between team members for each phase of the project.



Name	Begin date	End date	Duration
Documentation	9/20/10	12/9/10	58
Project Proposal	9/20/10	9/23/10	3
Functional Specification	9/23/10	10/14/10	15
Design Specification	10/14/10	11/14/10	22
Written Progress Report	11/15/10	11/18/10	3
Group Presentation	11/18/10	12/2/10	10
Post Mortem	12/2/10	12/9/10	5
Hardware Design	9/27/10	10/27/10	22
Braille dot raise system	9/27/10	10/27/10	22
Mechanical design integration	10/11/10	10/16/10	5
Power Supply Network	10/18/10	10/20/10	2
Software Design	9/21/10	10/26/10	25
Conversion program	9/21/10	10/21/10	22
Data transfer	10/21/10	10/26/10	3
Microcontroller Interface	9/27/10	11/10/10	32
Embedded program	9/27/10	11/10/10	32
CPLD Network	10/11/10	10/16/10	5
User Input	10/18/10	11/2/10	11
Testing & Modifications	10/27/10	11/20/10	18
Hardware Testing	10/28/10	11/4/10	5
Software Testing	10/27/10	11/4/10	6
Microcontroller Testing	11/10/10	11/20/10	8

Figure 3: Estimated Timeline

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7.1 Milestones

The figure below highlights the major milestones and documents required for submittal of this project.

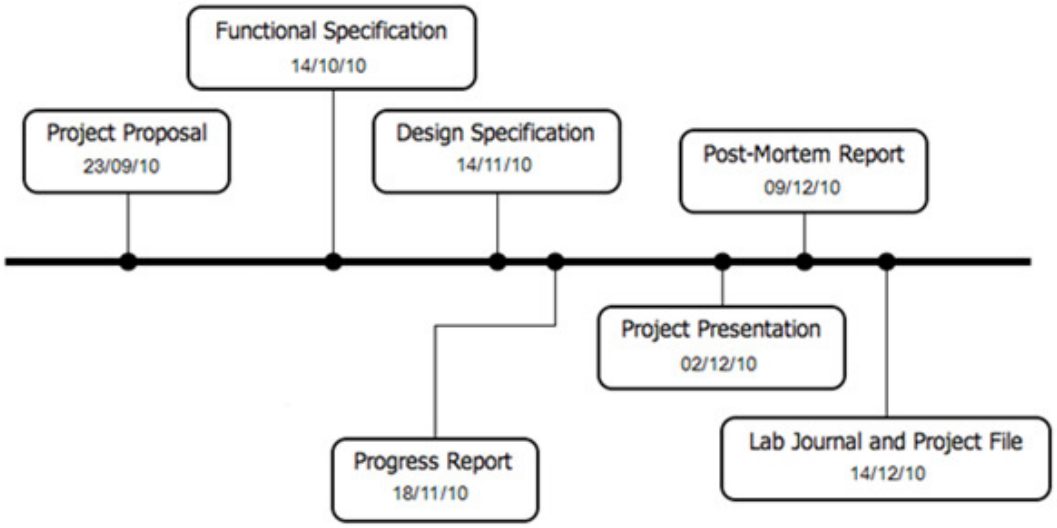

Figure 4: Milestone Chart

8.0 Team Organization

The Sense Solutions team consists of four talented Senior Engineering students at Simon Fraser University: Brendan Fairs, Yiran Du, Heedong Park and Rio Li. All members bring different skills and areas of expertise to the team, gained from a variety of co-op jobs and diverse elective courses. Their specific skills and experience are highlighted in the Company Profile section.

Sense Solutions has a loose organizational structure where everyone stands on an equal footing. Company roles are based on each individual's strengths and interests, yet specific leaders are chosen for each task so everyone has an equal share of responsibilities throughout the project. We believe in this way group dynamics will stay solid, as we each get a chance to lead.

Meetings will be held roughly once a week to discuss any major design concerns and to make sure everyone is on track. If any member has pressing concerns and desire a meeting to be scheduled, they can contact the group with a time that matches everyone's schedules. At these meetings everyone has an equal chance to hold the floor and major decisions will be based on a majority consensus. If such a consensus cannot be reached, the phase leader will cast the tie breaking vote. Minutes will be taken and distributed to all members via email.

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9.0 Company Profile

Brendan Fairs | Chief Executive Officer (CFO)

As a fifth year Computer Engineering student, I have much experience in both software and hardware design. Past projects have taught me how to work in a team environment to complete challenging tasks, and I bring my expertise in Software Engineering to this team. Having a co-op at Watanabe Engineering as an Electrical Designer/Draftsman, I also have the technical skills to help oversee the design and manufacture of the hardware systems as well. With strong leadership and communication skills, I will ensure the success of Sense Solutions.

Yiran Du | Chief Operations Officer (COO)

As a fourth year Electronics Engineering student with a comprehensive technical background and various industrial experiences, I believe I can do a good job as a Chief Operation Officer. As a software developer and tester at Faronics, I gained valuable skills with software troubleshooting as well as test case planning and development. Furthermore, my experiences at Point Grey Research expanded my knowledge of image acquisition and processing, sensor calibration and other basic hardware skills. As COO of Sense Solutions, I will ensure the company works smoothly and effectively.

Heedong Park | Chief Finance Officer (CFO)

I am a fifth year Electronics Engineering student at Simon Fraser University. My work experience includes two engineering co-op positions at Nokia and one under a professor. I enjoy working on a project that may contribute to social benefit, especially for people in need. I was exposed to several programming tasks as well as small electronics design and microcontroller interfaced systems. This experience will be useful to complete tasks for our project.

Rio Li | Chief Technical Officer (CTO)

I am a fourth year Electronics Engineering student at Simon Fraser University with co-op experience at Bronto Skylife Ab Oy. I have programming experience in C++, Assembly, VB and VHDL. I am familiar with circuit design, testing, and analysis and enjoy working in electronics labs. In addition, I have experience building circuits using PCB boards, which is vital in building project prototypes.

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10.0 Conclusion

Although this technique for economical Braille embossing is feasible in theory, there are still many things that need further research, and it is expected that new questions will arise as research progresses. There are also valid points to be made when comparing our technique to commercially available embossers and other methods of recording information for the visually impaired.

Our goal for this project is to build and develop a working model from our proposed design specifications within the confines of our schedule and budget as proposed. The key to the success of the project lies in the team members with diverse strengths suited to mechanical design, software design and hardware design. With our current resources and a well defined strategy, we are confident that we will achieve our goal by the end of this semester.

Overall, our design will be very cost efficient with comparable quality to currently available products. If successful, *Elementium* can replace the similar products in the market with higher economic benefit for the visually impaired.

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11.0 References

[1] Canadian National Institute of the Blind, 2008. "Characteristics and Unmet Needs of Adults with Vision Loss in Canada." http://www.cnib.ca/en/research/projects/ExecutiveSummaryPALS2000SightImpairmentAnalysisCNIB.pdf.

[2] American Foundation of the blind, 2010, “Braille printer.” http://www.afb.org/ProdBrowseCatResults.asp?CatID=45.

[3] SZ Printing, 2007, “introduction to Braille printing.” http://www.shjy.cn/print47/print1200.htm (Chinese version).

[4] DigiKey Corporation, 2007. http://www.digikey.com.

[5] Rawicz, Dr. A. *Funding Available for Engineering Students: Wighton Engineering Development Fund*, 2007, http://www.ensc.sfu.ca/~whitmore/courses/ensc305/materials/Wighton_Fund.pdf.

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