January 31, 2018

Dr. Andrew Rawicz

School of Engineering Science

Simon Fraser University

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Burnaby, BC

V5A 1S6

RE: ENSC405(W)/440 Project Proposal - Ripple Reader- The Affordably Accessible Braille Reader of Tomorrow.

Dear Dr. Rawicz,

Please find our project proposal documentation for the Ripple Reader, enclosed within. Our mission, as a team, is to develop and test a text to braille (T2B) reader that is affordable, user friendly, and has the capacity to expand braille learning to the masses. By combining the latest in optical character recognition technology, powerful microprocessors, and innovative hardware design. Ripple Reader takes an innovative spin that is guaranteed to make a splash, if not waves, in the accessible technology industry.

This proposal will start with our guideline principles; followed by a brief overview of Ripple Reader itself; a detailed risk assessment; a condensed market assessment; and finally, an outline of LampLight Labs development time and associated costs. Furthermore, each team member has provided an executive summary as to familiarize yourself with LampLight Labs.

LampLight Labs consists of five passionate and motivated individuals including Caelan Midwood, Connor Heidema, Randeep Shahi, Amir Hadjifaradji and Abiman Mahendra. Should you have any questions or concerns feel free to contact our COO Connor Heidema at any time. You can reach him at 604-868-9195 or by email at cheidema@sfu.ca.

Best Regards,

Caelan Midwood

Chief Executive Officer

LampLight Labs

Enclosure: Proposal for Ripple Reader

LampLight Labs

Presents

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Issued On: January 31st

Executive Summary

According to the World Health Organization (WHO) there are approximately 45 million legally blind people in the world [1]. These people have vision loss beyond the corrective properties of glasses or contacts. Sadly, a clear majority, ~90%, are braille illiterate and cannot harness the tactile sensitivity of their own hands to their utmost capability. This statistic is recent since of over the last 50+ years braille literacy rate amongst the visually impaired have been dropping [2]. There are multiple factors that have led to today's dwindling braille reading population but one major issue, identified through research, is affordable access to technology that promotes braille learning [2].

This issue of accessibility is just further compounded by the fact that like any language, braille is best learnt at a young age, but a large demographic only begins to lose their vision in their middle to late age. For these older individuals, the transition from full to partial, or zero, vision can be debilitating enough without the added difficulty of mastering a new language. As such, Ripple Reader is desired as an age agnostic educational device that can be tailored, by the user, to meet their exact learning needs.

Fortunately for LampLight Labs, we had the opportunity to talk directly to Canadian National Institute for the Blind (CNIB)'s Jennifer Yankanna, Manager of Programs and Services at CNIB's BC office, and two volunteers: Tommy and Samita. Through an insightful and illuminating meeting, LampLight gained firsthand knowledge of the everyday trials and hardships encountered daily by those with vision loss. One of the major takeaways was that the current braille technology on the market was far too expensive, retailing from $450 to $10,000 per device.

At LampLight Labs, we are poised to start the development of Ripple Reader, the affordably accessible braille reader of tomorrow, which would allow users to convert any digital or analogue written source to braille on the fly at reduce retail price. Furthermore, Ripple Reader will utilize real-time user analytics to optimize not only the update rate of the braille cells (to reduce power and device complexity) but to provide audio feedback, if desired, to enhance the educational value and versatility of the final product.

LampLight Labs strongly believes everyone should have equal access to all forms of print media (digital or analogue) and have the freedom to expand their lives in whatever way they deem fit. By developing Ripple Reader, we are not only providing a temporary solution to those suffering from visual impairment but, ideally, a transformative device that will help inspire, encourage, and grow these individuals by providing an accessible means to conveniently access the millions of written sources with the brush of their fingers.

As such, Ripple Reader is more than merely an accessibility tool but a statement that those with the capability, and capacity, to make a difference are choosing to support those that may not be able to do so on their own. Consequently, LampLight Labs is pleased to introduce you to our vision, goals, and, most importantly, Ripple Reader in the rest of this document.

Table of Contents

Figures

Tables

1. Introduction

With the rapid advancement of technology, many readily available resources such as text-to-speech and audiobooks allow anyone to listen and communicate without ever looking at a single character of text. With such technology, it may be easy to dismiss those who are visually impaired, with questions such as: is braille an archaic language and why can they not rely on the resources mentioned above? While these advancements help our everyday life, they do not suffice for complete independency. There are many drastic consequences on having a complete dependency on speech output and print-magnification technology.

In the 1960's over 50% of students who were blind were literate in Braille [3]; however, since 1963 there has been a decline in braille readers [4]. Today, the literacy rate among students who are visually impaired has gone down to approximately 10% [2], [3], "50% of students who are blind dropout before graduating High School, 70% of blind adults are also unemployed and 75% of individuals who are illiterate are on government assistance" [3]. Illiteracy has a major impact economically as well, the World Literacy Foundation [5] estimated the cost of illiteracy in Canada to be $32 billion USD. Some reasons cited are workplace accidents and other health care related issues [6].

With such an alarming rate of illiteracy, we need to ask ourselves, where does the problem lie? The causes for decline have been up for debate; however, a large percentage of the issue pertains to a lack of teachers' knowledge and method for teaching braille, not having enough resources and negative attitudes towards braille. [2] With our product, the Ripple Reader, we intend to address these issues. We want to help improve accessibility and affordability of educational tools aimed at facilitating and accelerating the process of learning braille. In doing so, we hope to minimize any stigma for people who read braille through input and validation from the CNIB.

While most devices in today's market (Canute, Tactile, Orbit Braille Reader, braille pages) can aid with reading braille, there are some very significant issues with them. Most notably is the cost; most of these devices are costly as they use a lot of expensive electronic parts (Tactile and Orbit Braille Reader) and can be very bulky (braille Pages).

The innovative design the Ripple Reader would be built on could notable reduce the price of other means of accessing braille today while minimizing changes in existing technology today. This would in turn mitigate any pushback the target market would have over our product.

Our target audience is young people, students, who want to learn braille, and improve their reading and writing abilities. As a secondary target audience, we want older individuals, those who develop vision loss later in life, to have the opportunity to learn braille, read material in their surrounding and dispel false norms and misconceptions surrounding braille.

2. Guiding Principles and Benefits of Product

As with any technology-based research and development project for enhancing one's life, there are numerous subsystems that most work harmoniously to successfully deliver a seamless user experience. This type of experience is especially important because Ripple Reader has the potential to broaden the everyday lives of 100,000s of partially, or completely, blind individuals all over world. Bearing this in mind, LampLight Labs has identified that affordability; ease of use; and educational value will be our three guiding principles for this endeavor.

2.1 Affordability

To meet the stated goal of affordability from the eyes of the customer, extensive measures have been made to optimize existing mechanisms for dynamically altering braille character arrays using a highly experimental mechanical branching system to reduce the overall size, weight, and power requirements when compared to our competitors.

Furthermore, special attention has been and will continue to be given to the development of an overall systems architecture geared towards the ease of maintenance and repair through the appropriate choice of mechanical assembly designs; materials; and compartmentalization of subsystems.

2.2 Ease of Use

Since Ripple Reader must meet the exacting standards of braille both, standard and contracted versions of the language, in terms of both translation over characters and tactile feel itself. This project has a near clinical level of specificity for the product to be successful with its intended purpose. This specificity will be discussed in later documentation.

Assuming the dimensional requirements of braille are met, the final idealized product will take cues from ergonomic handheld devices, such as video game console remotes, and the unique needs of the partially sighted to develop a portable device with the snap-and-view properties of a digital camera and usability of an e-book. Thus, maximizing the practicality of any solution while simultaneously minimizing the stigmatization associated with using a device of assistance.

Finally, depending on the loaded software and braille library conversion tables. Ripple Reader is theoretically print language agnostic. Thus, non-English readers could utilize the device as well.

2.3 Educational Value

The final guiding principle is to maximize the educational value to students of all ages and experience through the proposed, but not guaranteed, incorporation of basic and advanced braille learning features such as contracted braille language and auditory feedback of current character (or word) being read.

Furthermore, the guiding principles of affordability amplifies the educational value of this device because a non-visually impaired individual will be, ideally, able to repair basic mechanical functionality of the device.

3. Systems Overview

As Figure 1 shows, Ripple Reader is a multistage analogue to digital to analogue converter for braille that utilizes several main components.

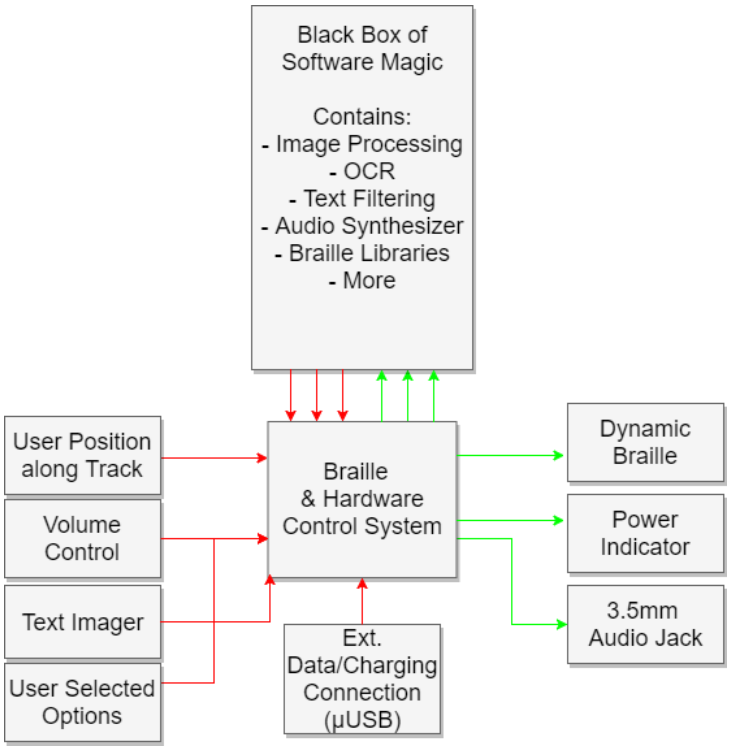


Figure 1: System Overview

Due to the emphasis on our guiding principles have on this project. LampLight Labs has designed two different configuration options of Ripple Reader. *Configuration A: Onboard Processing* is geared towards an individual who does not have access to a smartphone while *Configuration B: Off-Board Processing* harnesses the ubiquitousness of the billions of smartphones worldwide to reduce final cost [7].

Configuration A represents Ripple Reader as a complete all-in-one text to braille device but bestows additional cost onto the end user. While *Configuration B,* offloads specific computations to an existing smart device via an Android/iOS companion app tethered via Bluetooth.

Regardless on the ultimate option pursued. Ripple Reader will be comprised of: a text imager; open-source image manipulation software for noise reduction and text extraction; optical character recognition software; dynamic braille cells; and each subsystem's associated control systems.

Furthermore, Ripple Reader has the proposed capability to use real-time user analytics to give real-time audio feedback to the user and adjust braille character cells on a need-to-know basis.

Finally, by designing Ripple Reader with the potential to offload certain processing requirements from the very start. The research and development phase can be expediated by allowing different teams to work on individual subsystems simultaneously without the fear of miscommunication.

This accelerated development phase is only possible because Ripple Reader's inter-board data transfer protocol will be established such that it can be expressed in Bluetooth or hardware friendly packets. Figure 2 below demonstrates the four main functionalities of Ripple Reader. Lamplight Labs apologizes for the miniature text by Figure 2 was initially designed for as an investors slide deck.

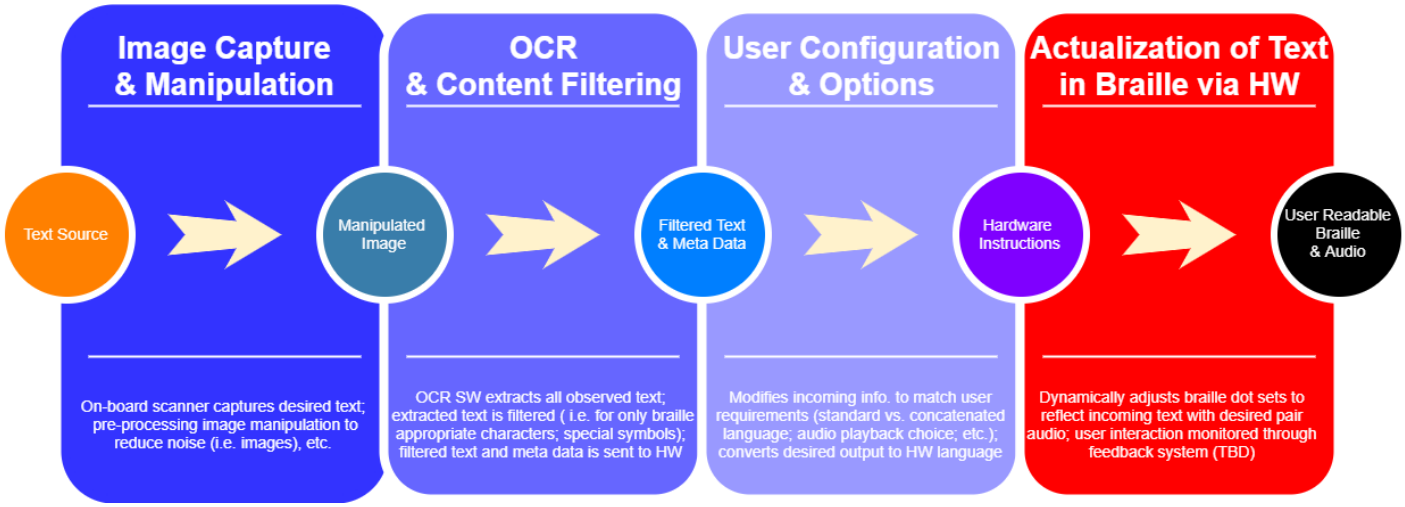


Figure 2: Principle data path within Ripple Reader for the conversion of written text to braille.

4. Risks

The following table, Table 1, details the risks of the project. Details may be found in Appendix I.

Risks	Severity	Likelihood	Impact Area	Mitigation Strategy
Team members may become ill	Minimal	Medium	Any part of the project can be affected depending on who gets sick and when	Our team has multiple members in each domain of expertise so that if one person becomes ill, another member can take over the ill members duties
Feature Creeping inflates the scope of the project	Significant	Medium	The project will have constant delays which may prevent the product from achieving fruition within the launch window.	Project members must all agree on the scope of the product and not add features without further analysis being performed on the viability and rate of return of the feature
Project timeline is miscalculated	Severe	Low	The entire project could be affected as an unforeseen critical path could block development	The timeline will be reviewed and revised multiple times throughout the project launch window
Stakeholders disagree on what the product should be or what it should be capable of	Minor	Medium	Stakeholders may request changes to the product that could have a sizable impact on the products original timeline and purpose	We will frequently communicate with Stakeholders to update them with our design implementations. Concerns from the stakeholder will be taken into consideration during planned review sessions
Stakeholders become disengaged with the product and stop communication	Moderate	Low	If stakeholders become disinterested, we will lose our ability to ask our target audience for feedback	We will keep the stakeholders informed about the progress of the project to remedy any concerns they may have

Risks	Severity	Likelihood	Impact Area	Mitigation Strategy
Project is not communicated coherently with the stakeholders	Significant	Low	The product may lack significance for the stakeholders	The Group will be concise when communicating with any of the shareholders to avoid mistranslated ideas
Team misinterprets the projects requirements	Severe	Low	The entire project will be affected as the final product would not match the requirements specifications	The requirements will be strictly typed so that misinterpretations of the requirements can be minimized
If using a community 3D printer, printer may not be available	Moderate	High	Prototyping the design may take longer than anticipated and will affect the project timeline	The team will look into multiple different places to get our items 3d printed as to not rely solely on one machines functionality
The target audience may not find the product easy to use	Severe	Low	The product will not sell well and be a commercial failure	Constant communication with stakeholders and the target audience will mitigate this
Team may be unable to agree on a solution to the problem	Minimal	Medium	May cause the timeline of the project to be changed negatively	Every member will have the opportunity to voice their opinions and concerns about anything that pertains to the project during meetings
Failure to acquire financial support for the product	Minor	Medium	Project may not have sufficient funding to do everything that is proposed	The product will have requirements that are necessary different levels of requirements based on the funding we receive
Product may be too expensive that Consumers may buy the competition	Severe	Low	The product may become a commercial failure	The market price of the of the product will be compared with the competitor's products that are already in the market
Another company may come out with a similar product and beat us to the market first	Severe	Low	The product will be overshadowed by the first product to market and may not sell as well	Active research will be done to see what the market trends are, and we will adapt accordingly with changes being made to the schedule or requirements as needed.

Table 1: Risks Associated with Project

5. The Market

5.1 Competitors

As with most products, Ripple Reader has found itself in a proverbial “Red Ocean” in which corporations and individuals are constantly looking for iterative improvements or small tweaks to push their product to the top. Luckily, Ripple Reader is not primarily competing with the entire spectrum of braille related products but only what is known as “braille readers”.

Regardless, several technologies provide ease-of-use to the end user learning braille and these systems in specific shall be discussed. This includes in order of increasing complexities transcription programs, braille embossers, braille readers, reader-Apps, and advanced technologies.

At the most basic level, transcription programs (i.e. software) converts specially formatted digital text files to braille to be either printed or pushed to braille reader. Ripple Reader will use a custom transcription program, possibly based on ‘Braille Blaster’ [8], that is tailored to the conversion of text extracted from images.

Braille embossers are analogous to how printers work for text. They can take digital braille formatted files and emboss pages with their content for tactile reading. Though it is relatively simple to convert text to braille. Printing pages of braille is neither cheap nor fast with Braillo, a world leader in braille embossers. Entry devices retail from $23,000 to $117,000 [9].

Alternatively, braille readers are devices that express a set number of braille characters on a set of mechanically dynamic arrays to quickly express braille of a digital format without printing physical pages. One of the most affordable braille reader, the Orbit Reader 20 by APH, retails for $450 USD and has 20 refreshable braille cells [10] while the $1200 Canute by Bristol Braille Technology [11] has 360 braille cells. These extra cells provide a huge benefit to the end user as they do not need to switch the display of braille they are reading constantly.

Reader apps are mobile applications that enable users to experience the world around through audio descriptions, such what Microsoft’s Seeing AI [12], or captures specific written elements for conversion (as the KNFB Reader software [13] does). Unfortunately, KNFB Reader costs upwards of $100 USD and doesn’t include a physical braille reader.

Finally, there are newer technologies being developed today such as notetakers, the tactile display provided by Team Tactile [14] and the BLITAB [15]. Notetakers are devices that are built into a device like a tablet and often only have a few characters to work with. They allow users to interact online and do things one could usually do with a tablet. The most notable of these is the BrailleNote Touch [16]. These cost nearly $7000 but are incredibly useful for learning things straight off the internet. The tactile display is a braille display which can take a picture of any page of text and near instantly convert it into braille. This eliminates the need for a separate application to do the OCR. Finally, the BLITAB [15] is like a notetaker except rather than only providing the 18 characters provided by the BrailleNote, an entire screen provides the output. The Tactile display and BLITAB are still in early stages of development and have yet to make it to the market.

5.2 Our product

So, what makes Ripple Reader different?

Well, our product fits in the middle of all these products greatest relative values as shown in the Figure 3 below. It is more affordable than most hardware because of its design to conserve on the number of actuators used. It is also able to connect to a camera which allows pictures and OCR to be done on images and be displayed to the screen much like the Tactile display and a KNFB linked braille reader. Further is can act as a regular reader by plugging into a computer. Finally, it has educational abilities as when the user is stuck at any point in the braille reading, audio feedback may be provided assisting the user to learn the language.

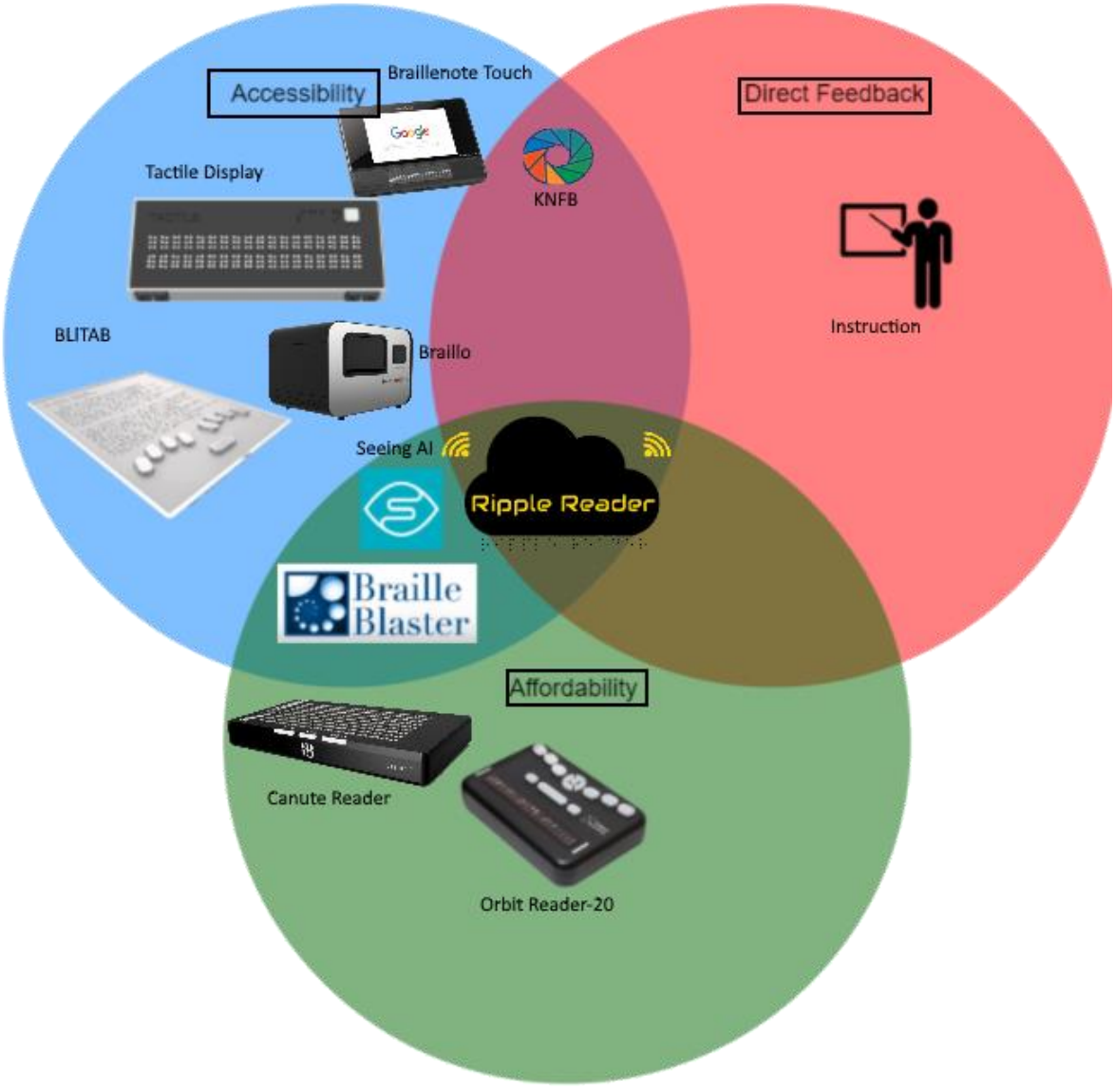
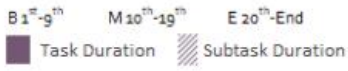


Figure 3: Our competitors in the market of assisting the visually impaired in learning braille

6. Project Plan & Milestones

Figure 4 shows the expected timeline for the project. After much deliberation it was found that the hardware would likely stifle our progress the most as open-source libraries such as Liblouis [17] will be available to develop the software.



ACTIVITY	START (date)	DURATION (days)	End (date)
Documentation	**10-Jan**	**87**	**07-Apr**
Project proposal	10-Jan	19	29-Jan
Requirements Specification	29-Jan	21	19-Feb
Design Specification	19-Feb	35	26-Mar
UI Design Appendix	19-Feb	35	26-Mar
Poster	26-Mar	12	07-Apr
Research/Design	**08-Dec**	**51**	**28-Jan**
Finding a problem to solve	08-Dec	33	10-Jan
Finding an appropriate solution	10-Jan	5	15-Jan
Finding appropriate materials	15-Jan	13	28-Jan
Buying materials (POC)	28-Jan	11	08-Feb
3d Printing	**01-Feb**	**27**	**28-Feb**
Solidworks design	01-Feb	7	08-Feb
Printing	08-Feb	20	28-Feb
Application	**01-Feb**	**35**	**08-Mar**
UI/UX	01-Feb	14	15-Feb
Functionality	01-Feb	30	08-Mar
Sensors	**15-Feb**	**28**	**15-Mar**
Hooking actuators to processor	15-Feb	10	25-Feb
Connecting actuators to 3d print	28-Feb	6	05-Mar
Configuring location position	01-Mar	14	15-Mar
Insert bluetooth sensor	01-Mar	14	15-Mar
Frame	**10-Mar**	**10**	**20-Mar**
Building an appropriate frame	10-Mar	6	16-Mar
Putting product inside of frame	15-Mar	5	20-Mar
Integration and Testing	**20-Mar**	**12**	**01-Apr**
Getting code to push actuators based on sensor	20-Mar	5	25-Mar
Sanity Testing / Edge case testing and analysis	25-Mar	7	01-Apr

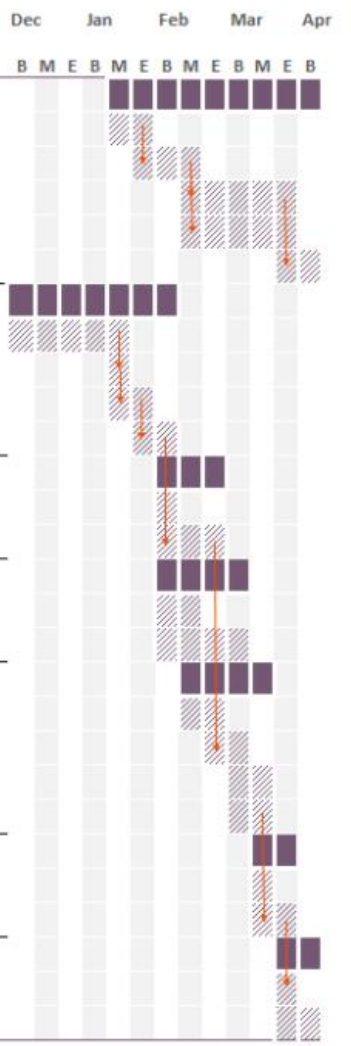


Figure 4: Gantt chart (Critical path in orange)

7. Cost Considerations

The cost considerations have been broken down into the following sub categories,

1. Research and Development
2. Procurement and Assembly

7.1 Research and Development Costs

Research and development costs in Table 2 below take into consideration all possibilities in terms of equipment and assembly that will be investigated for optimizing our product to adhere to the design standards. If a method or technology is found that satisfies our needs, any further research or development will be done in that category

Linear Motion Generation per braille pin	Linear Actuators	$40
	Reciprocal Motion	$10
	Pneumatic Actuators	$60
	Novel Motion Link System	$100
Power	Battery	$30
	Motor Control Board	$100
	Power System	$50
Image Capture & Manipulation Board	Micro FPV Camera	$20
	Processing Board	$30
	Artificial Lighting	$10
	Ambient Light Control System	$10
Central Control Board	Interconnection Cables	$10
	Board	$25
	Buttons	$5
	Audio	$10
	User Feedback System	$30
Enclosures	Main Enclosure	$50
	Linear Motion Mounts	$20
Misc	Miscellaneous	$30
	Duct Tape & WD40	$20
	Reverse Engineering	$80
Buffer (20%)		$77
Total		$607
Total w/ Linear Motion		$820

Table 2: Cost of Research and Design

7.2 Procurement and Assembly

The procurement and assembly cost in Table 3 below reflect the capital required to purchase all the parts, integrate them and assemble them according to the finalized product design.

Item	Units Estimate	Unit Cost Estimate	Description	Total Cost
Primary PCB	1	$25	For image processing, and converting text to both Braille and audio	$25
Secondary PCB	1	$25	For operating actuators and locating finger position through tactile sensing	$25
Camera	1	$15		$15
Bluetooth Transmitter/ Receiver	1	$15	For transmitting and receiving data from smartphone	$15
3.5mm audio jack	1	$2	For audio output	$2
Actuators	24	$5	One for each Braille pin constituted within 3 Braille characters (3*8)	$120
Braille Character Assembly Units	8-20	$0.50	For Braille output	$10
Directional Buttons	4-5	$0.60	For navigating along a line of text and/or accessing the preceding or succeeding line	$3
3D printed actuating link network	1	$15	Since only 3 characters (previous, current, next) are actuated the link network will duplicate the characters to the rest of the Braille character assembly units	$15
Product Housing	1	$10	Housing for the entire assembly	$10
Infrared/Copper feedback sensors	1	$20	To keep track of where the finger is, an infrared sensor will be used to measure the distance, another option will be to complete a conductive circuit by having thin strips of copper throughout the outside of the device.	$20
				$260
Total cost of procurement, production, and assembly per unit				
Total cost of procurement, and assembly per unit with 20% buffer				$312

Table 3: Cost of Procurement and Assembly

8. Funding

So far, we have approached the CNIB in terms of funding our project. They seemed interested in how our design works and were especially interested in the affordability of the final product. We have also investigated how each of us can provide to the project if funding doesn't turn out. Even without proper funding, the scale of this project does not exceed the amount of which we are all willing to spend if worse comes to worse.

Currently we are preparing to present our idea to the SFU IEEE in hopes they see the value in our project and provide appropriate funding. We will also be going back to the CNIB to more easily provide them a product they can use.

In the coming months we have several other avenues to explore in terms of funding. The most obvious of these funds includes the Whighton Fund which we will send an application for next semester. Another source of funding may be provided by Engineers Canada. In March the organization hosts the National Engineering Month. Here they entice engineering minds to come up with innovative inventions and fund projects which seem appealing to them. We hope to send an application out to this group in March. Finally, there is a place to find funding through crowdfunding. We intend to develop a video that better describes our product along with our design specs which will encourage people to fund our project and get us to where we want to be. Financially.

Currently we are unaware about the exact amount that will bestowed from each source to our project. It is hoped that all the sources for contribution will cover the majority, if not, all the cost. If there are any outstanding expenditures to be met, they will be covered through personal contributions.

9. Employee Profiles

Caelan E. Midwood

Chief Executive Officer

Caelan is in his sixth year in Systems Engineering, old-curriculum, program at Simon Fraser University and has nearly completed all the requirements for his BASc degree.

His industry experience working with ruggedized all-weather unmanned aerial systems (UAS); the global commercialization process of the world's first optical-electronic synthetic aperture radar (SAR) processor; and his participation in SFU's NATO Field School has allowed him to develop an awareness, and taste, for the complexities of management; interpersonal relationships; and effective communication ideal for his position as CEO.

Connor Heidema

Chief Operating Officer

Connor is in his fifth year in Computer Engineering at Simon Fraser University. He has developed a strong foundation of academic knowledge there including constructing effective circuits and wireless network protocols. During this time, he also worked at numerous internships including SKYTRAC systems where he programmed flight navigational units with continuous feedback data. Further at the research lab MENRVA, Connor helped develop a website to store study data for researchers along with created software to simulate hand movements. Most recently Connor has been working at Left developing on the wireless communication mesh platform RightMesh.

Amir Hadjifaradji

Chief Technical Officer

Amir is in his fourth year in Biomedical Engineering at Simon Fraser University. He has undertaken many projects in the field of medical imaging and processing, among such include image cytometry for cancer cells and statistical analysis on retinal-related diseases. He maintains a strong interest in keeping up-to-date in current electronics, computers and biomedical applications. With internships at Plexia Medical Systems and PNI Inc, Amir has a full year of web development experience designing and maintaining sites for doctors all over British Columbia and multinational companies.

Randeep Shahi

Chief Software Architect

Randeep is in his fifth year in Computer Engineering at Simon Fraser University and has a large interest in embedded engineering. Randeep has had a 4-month internship at T2 Systems where he was first exposed to the embedded workflow and inspired him to continue this passion and acquire an additional 8-month Coop at Delta Controls in which he was exposed to the many processes involved in this engineering. Aside from his internship experience and passion, Randeep is currently interested in learning about how the internet works.

Abiman Mahendra

Chief Hardware Architect

Abiman is in his fifth year of undergraduate studies in systems engineering at Simon Fraser University where he has gained fundamental knowledge in programming, embedded systems, control systems and robotics of which, he holds the latter two close to heart. Abiman has co-op work experience in the renewable energy and semiconductor industries working at RMA Energy Consultants and Microsemi respectively. At RMA he helped with the optimization of transmission networks and at Microsemi he helped implement functional coverage and functionality to the transport layer test bench for a SAS/SATA port controller.

10. Conclusion

The Ripple Reader is, undertaking a mission to provide young visually impaired people an independent learning tool to be literate in braille. According to statistics by the WHO [18], 19 million children below the age of 15 are vision impaired. Of these, 1.4 million have irreversible blindness. Also, according to data provided for the year 2016 by the American Printing House for the Blind [3], around 65,500 legally blind students are registered in elementary and high schools throughout the United States. We aim to reduce these statistics by bringing our product to the market.

The CNIB places great emphasis on braille literacy [18] as it will enable independence, equal opportunity and employment for persons with vision impairment. They have throughout the past provided help educating the visually impaired with literacy but are constantly looking for more affordable means in which to teach people and give them the access to information.

The Ripple Reader provides the capability of converting text to both braille and audio thus enabling tactile learning via audio reinforcement. The product is aimed at a niche market. Even though similar devices do currently exist, they do not provide the learning capability, the affordability or the ease of use that the Ripple Reader is aiming to offer, especially to children in developing countries who cannot afford such expensive devices.

Currently the team is mulling over two different prototypes of the device. The key difference being on board processing via an IC and offboard processing via a smartphone. While off board processing via a smartphone offers a lot of processing power and less complications, on board processing will be a self-contained unit forgoing the issue of having to depend on a smartphone to function.

Having done an in-depth risk assessment, we understand certain issues might crop up during the development of the product, such as feature creep, exceeding budget calculations or the product not being affordable enough. There may also be other issues we did not have a forethought on. However, we are confident that such issues can be avoided by careful planning and smart decision making.

The mere thought of enabling visually impaired people to become independent, and literate in Braille is enough to motivate us to pursue this project. We will work our hardest to ensure the most optimized product comes out of this project. Though the path we have chosen is not an easy one, we are excited to combat the challenges ahead, and we hope our innovations will create a ripple effect, ultimately changing the lives of the many millions of potential users lives.

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Appendix I

Following are guidelines the group MITRE use to analyze risks brought forth from a project [19].

Severity	Description
Severe	A risk event that, if it occurs, will have a severe impact on achieving the desired results, to the extent that one or more of its critical outcome objectives will not be achieved
Significant	A risk even that, if it occurs, will have a significant impact on achieving desired results, to the extent that one or more stated outcome objectives will fall below acceptable levels
Moderate	A risk even that, if it occurs, will have a moderate impact on achieving desired results, to the extent that one or more stated outcomes objectives will fall well below goals but above minimum acceptable levels.
Minor	A risk event that, if it occurs, will have a minor impact on achieving desired results, to the extent that one or more stated outcome objectives will fall below goals but well above minimum acceptable levels
Minimal	A risk that, if it occurs, will have little or no impact on achieving outcome objectives

Table 4: Table of Severity [19]

Risk	Probability of Occurrence
High	65% - 100%
Medium	35% - 65%
Low	0% - 35%

Table 5: Table of Probability [19]