

# **Hofstra Senior Design Project Proposal**

## **Text to Braille**

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## Introduction

This senior design proposal is for a text to Braille application and device. The objective is to teach by providing translations with a click of a button. The concept is to make both an application that will take an input from a phone or website (Figure 3) and a physical medium that will output the text into a physically touchable and readable version (Figure 2), as braille needs to be touched to be of use. Braille is the one of the most important methods that the blind have in navigating everyday life: from bathroom signs, restaurant menus, and in European Union countries is is mandatory for pharmaceutical packaging to include braille<sup>1</sup>. In terms of literacy and education, braille is essential for those with vision loss because of the Individuals with Disabilities Education Act, which states “In the case of a child who is blind or visually impaired, provide for instruction in braille and the use of braille unless the IEP Team determines, after an evaluation of the child’s reading and writing skills, needs, and appropriate reading and writing media (including an evaluation of the child’s future needs for instruction in braille or the use of braille), that instruction in braille or the use of braille is not appropriate for the child<sup>2</sup>,” this states that unless the IEP team determines otherwise, any child who is visually impaired or blind must be taught braille.

## Why Braille

Braille is a very important language, yet almost all the tools available for braille users are fairly dated and very expensive. Although in the modern day the necessity of braille seems to be low due to technology such as screen readers, braille displays, and speech recognition software, it is not to say that the language is unnecessary in the technological modern day. Instead braille is now more important and more easily accessible to the public. Non-profit organization such as The National Federation of The Blind Jernigan Institution, National policies such as the Individuals with Disabilities Education Act, and modern technology such as braille embossers<sup>3</sup> has made braille

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<sup>1</sup> Botta, Mike. “Braille in Pharma: Differing Views in the U.S. and Europe.” *Pharmaceutical Processing World*, 11 Oct. 2019, <https://www.pharmaceuticalprocessingworld.com/braille-in-pharma-differing-views-in-the-u-s-and-europe/>.

<sup>2</sup> Individuals with disabilities Education Act, statute/Regs main, Statute, Subchapter II (Part B), section 1414, D, 3B III, <https://sites.ed.gov/idea/statute-chapter-33/subchapter-ii/1414/d/3>

<sup>3</sup> *In America - National Federation of the Blind*. [https://nfb.org/images/nfb/documents/pdf/braille\\_literacy\\_report\\_web.pdf](https://nfb.org/images/nfb/documents/pdf/braille_literacy_report_web.pdf).

more accessible, affordable, and acceptable to everyone who wants or needs to learn braille.

One important question that one might ask is, what other options do children with visual impairment have in terms of Literacy and education? The answer, if they are still visually enabled: enlarged print, a change in the standard print such as an increase in contrast, the use of optical devices to enhance the visibility of a document, are some options to help allow these children to have the same advantages that children with normal vision have in terms of reading books or documents. However, this does not mean that the children should not learn braille, as stated in *Defining Literacy for Individuals Who are Blind or with Visual Impairments: A Qualitative Study of Stakeholders* “There were students who had low vision and because of their etiology were gradually losing their vision to the point of being legally blind, but were still encouraged to use their vision at that point in time instead of being taught braille. This led to the 1990s low rates of literacy and many literacy barriers (Koenig & Holbrook, 2000)<sup>4</sup>”. On the other hand, If their residual vision is very low and standard print is not visible regardless of magnification or any other enhancements in visibility, then only braille or auditory materials are left as a choice for literacy.

## Statistics

Ye Wang from Missouri state university and Shariffa Khalid Qais Al-Said Sultanate of Oman in the *Journal of Ethnographic & qualitative research* 2014, vol 8, named “*Defining Literacy for Individuals Who are Blind or with Visual Impairments: A Qualitative Study of Stakeholders*” state

- “In every 1,000 school-aged children, there is approximately one child with blindness or visual impairments in the United States (Council for Exceptional Children, 2012)...Roughly 10% of children with visual impairments are legally blind, and approximately 10% of these children who are legally blind use braille as their primary reading medium (Council for Exceptional Children, 2012)”<sup>5</sup>

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<sup>4</sup> Ye Wang, and Shariffa Khalid Qais Al-Said. “Defining Literacy for Individuals Who Are Blind or with Visual Impairments: A Qualitative Study of Stakeholders.” *Journal of Ethnographic & Qualitative Research*, vol. 8, no. 2, Winter 2014, pp. 99–112. EBSCOhost, search.ebscohost.com/login.aspx?direct=true&db=asn&AN=95101184&site=ehost-live.

<sup>5</sup> Ye Wang, and Shariffa Khalid Qais Al-Said. “Defining Literacy for Individuals Who Are Blind or with Visual Impairments: A Qualitative Study of Stakeholders.” *Journal of Ethnographic & Qualitative Research*, vol. 8, no. 2, Winter 2014, pp. 99–112. EBSCOhost, search.ebscohost.com/login.aspx?direct=true&db=asn&AN=95101184&site=ehost-live.

According to the National Federation of the Blind jernigan institute in a 2009 report named “Facing the Truth, Reversing the trend, Empowering the blind”<sup>6</sup>

- “Fewer than 10 percent of the 1.3 million people who are legally blind in the United States are braille readers. Further, a mere 10 percent of blind children are learning it.”
- “Each year as many as 75,000 people lose all or part of their vision. As the baby-boom generation moves into retirement age and as diabetes (the nation's leading cause of blindness) approaches epidemic proportions, the NFB expects this number to increase dramatically and, if nothing is done, the braille illiteracy rate as well.”
- “The current effects of this crisis are dire. Over 70 percent of blind adults are unemployed, and as many as 50 percent of blind high school students drop out of high school.”

Brian W.Stone, Donovan Kay, and Anthony Reynold from Department of Psychological Sciences, Boise State University in the Journal of Statistics Education Volume 27, 2019 Issue 3, page 225-237, the article named “Teaching Visually Impaired College Students in Introductory Statistics”<sup>7</sup> state

- “Research asking BVI students about their experience report that many teachers “failed to provide instructions in classes in a way that included students with [visual impairments]. Often this was the case because teachers did not adapt classroom instructions, or neglected to provide them with accessible resources” (Whitburn 2014, p. 149). Teachers may recognize the importance of providing accommodations but not know how to do so (Hawley, Cardoso, and McMahon 2013).”

## **An Idea**

The idea for a Teaching braille app is to provide a low-cost option to those who want to learn or practice braille.

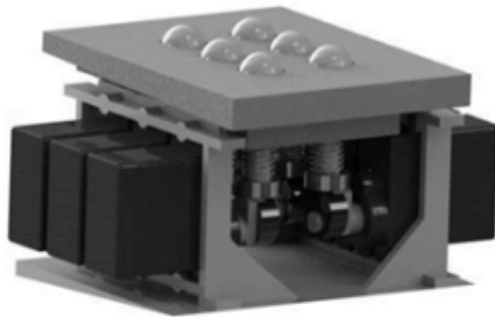
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<sup>6</sup> *In America - National Federation of the Blind*. [https://nfb.org/images/nfb/documents/pdf/braille\\_literacy\\_report\\_web.pdf](https://nfb.org/images/nfb/documents/pdf/braille_literacy_report_web.pdf).

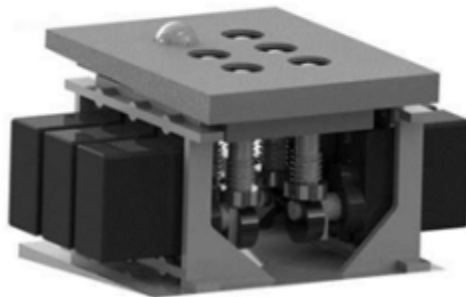
<sup>7</sup> authors, All, and Brian W. Stone. “Teaching Visually Impaired College Students in Introductory Statistics.” Taylor & Francis, <https://www.tandfonline.com/doi/full/10.1080/10691898.2019.1677199>.

## Previous Work

The only application and device that is available and very modernized is the braille note touch plus 32 or brilliant bi 40x braille display which were developed by humanware, which are very expensive costing upwards of two thousand dollars and this can be off putting to low income families. In addition the available braille note takers seem to target those who already have a solid understanding of braille rather than those trying to learn braille.



a.



b.

Figure 1. *Servomechanism made with 6 Micro Servo Reading Goteck (GS - 9025MG), each “pin” has two positions: protruding (Figure a) or hidden (Figure b);*<sup>8</sup>

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<sup>8</sup> Duarte-Barón, Katherin, et al. “Design and Construction of a Device for Facilitating the Learning of Braille Literacy System.” *Ingeniería y Competitividad*, vol. 18, no. 1, 2016, p. 77., <https://doi.org/10.25100/iyv.v18i1.2179>.

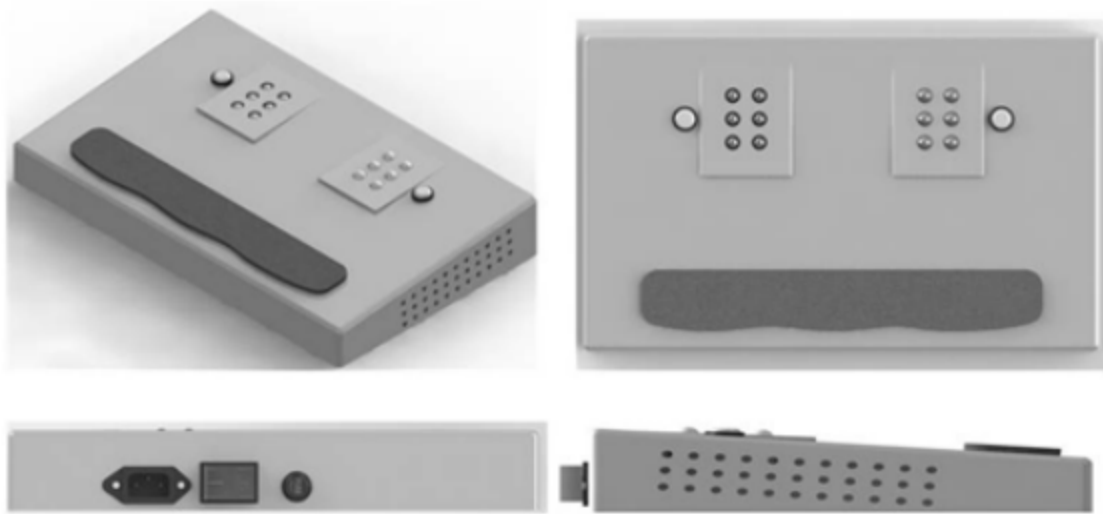


Figure 2 - Structural design made of two servomechanisms, two buttons indicating End and Next, a switch on - off, a fuse, a connector for the power supply, and a padded wrist rest.<sup>9</sup>

Paste or enter text:

Language:

Figure 3 - A. web page design with space to enter desired text, choice of language, and start button to begin translation

<sup>9</sup> Duarte-Barón, Katherin, et al. "Design and Construction of a Device for Facilitating the Learning of Braille Literacy System." *Ingeniería y Competitividad*, vol. 18, no. 1, 2016, p. 77., <https://doi.org/10.25100/iyc.v18i1.2179>.

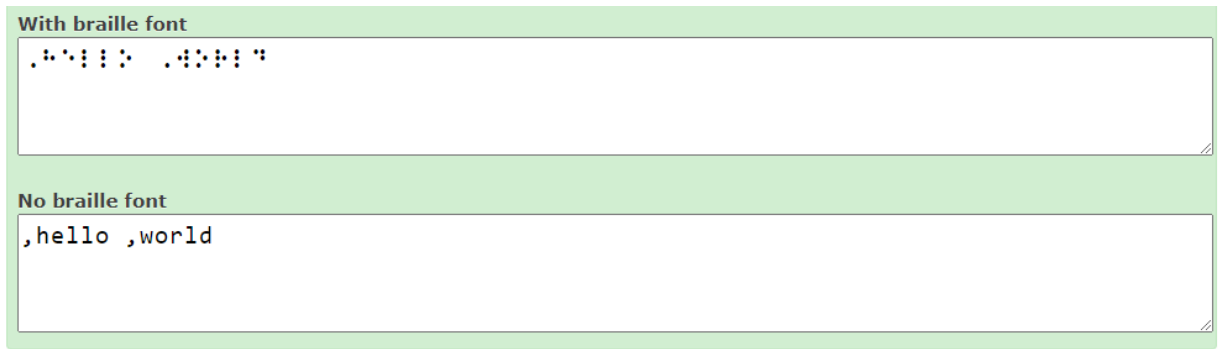


Figure 3 - B. *Result of translation, showing both the originally entered text as well as the result in braille*

## Research Questions

**What is the problem we are trying to solve?**

- To develop an affordable braille teaching board.

**How will we achieve our goal?**

- We will make an application to communicate with the Braille Board.

**Who is the User?**

- The board is intended to be used for educational purposes and will be targeted to children in middle to high school.

**How is this interaction?**

- 1) Example 1) A teacher who is not blind and teaches braille is teaching their student who can either be or not be blind.
- 2) The teacher wants the student to read out a sentence that the teacher chooses.
- 3) Thus they type a word or sentence in the application as seen on figure 3.
- 4) then the result is sent to the Braille board for the student to feel and then read out as seen in figure 2.

## Plan of Work

**Components to construct:**

- 1) Application

- A simple application that will be the main component for communication to the Braille Board.
- This component will be a website or mobile app.

## **2) Braille Board**

- A Board that can read information from the application and translate it to braille much like the braille notetakers currently in the market.
- The main focus of the Project. This will take most of the research time.

## **3) Connection Component**

- Being able to transfer the information between the app and the physical board
- The second most important component, will mainly focus on methods to connect the braille board and the application so that the board can read the information being sent to it and then change accordingly.
- wifi model is easier, bluetooth is also an option but more difficult.

## **Timeline**

- 1) Research into how to make the physical component.**
- 2) Research into how best to connect the physical component to an application of some form.**
- 3) Research into making an application that will be used to transfer information to the physical board..**
- 4) Experimentation on a development application such as TinkerCad to develop the board before physically making it to make the process simpler and more efficient.**
- 5) Making an application that can translate english to braille.**
- 6) Make a Braille board based on the Experiment.**
- 7) Connect the two components.**
- 8) Lots of testing.**

## **Extra Challenges**

- 1) make a method to scan documents and allow the Braille board to read said document.**



## **2) Text to speech.**

### **Conclusion**

In conclusion, although there are models of a text to braille device, it would not take away from the experience nor the novelty of making a simplified and inexpensive version. The task would require both programming and engineering to make both the application as well as the device. Perhaps as the first major project that we would be taking, the difficulty of the assignment will be something that we underestimate. Nonetheless it is an interesting Senior Design Project to consider and would be an interesting experience to undertake this project.

### **User Stories**

US-1: Start up device for initial use by pushing a button to initialize Bluetooth pairing. The device is paired via Bluetooth to a computer and the user can now use the device. LED light on the device should be on to indicate the device is working correctly.

US-2: Translate any English statement of length 1-1000 characters into braille by opening the application, inputting their text to be translated and clicking on the start button to begin showing the text. Then the translation gets sent to the device which pops its buttons to begin feeling for braille.

US-3: View the next character of their input as only two characters may be shown at a time since there's only so much space. There is a previous and next button to cycle between characters. Once all the characters have been exhausted, the following characters will display nothing.

### **Functional Requirements**

FR-1: When the start button is detected to be pressed, the device begins its initial startup by powering on all of its components and checking to see if there is a connected

external computer to receive input from. When a connection is established, a welcome and confirmation message will appear followed by the text box to enter input.

FR-2: Once there is input detected and translated the device will display the first two corresponding letters by activating its servos for each character to push out the bumps and display the correct letter in braille form.

FR-3: When the application is opened on the computer's end, a searching prompt will appear until a connection with the device is established. Once connected, input box will appear and begin to ask the user for english words/sentences to be translated. The input will then go through an algorithm that will translate the words into braille characters which will be displayed on both the output box in the application and on the physical device itself.

## References

- 1) Botta, Mike. "Braille in Pharma: Differing Views in the U.S. and Europe." *Pharmaceutical Processing World*, 11 Oct. 2019, <https://www.pharmaceuticalprocessingworld.com/braille-in-pharma-differing-views-in-the-u-s-and-europe/>.
- 2) Duarte-Barón, Katherin, et al. "Design and Construction of a Device for Facilitating the Learning of Braille Literacy System." *Ingeniería y Competitividad*, vol. 18, no. 1, 2016, p. 77., <https://doi.org/10.25100/iyc.v18i1.2179>.
- 3) Ibarra, Manuel J., et al. "Ñawinchay: Low Cost System for Facilitating the Braille Literacy for Blind People." *2019 14th Iberian Conference on Information Systems and Technologies (CISTI)*, 2019, <https://doi.org/10.23919/cisti.2019.8760729>.
- 4) *In America - National Federation of the Blind*. [https://nfb.org/images/nfb/documents/pdf/braille\\_literacy\\_report\\_web.pdf](https://nfb.org/images/nfb/documents/pdf/braille_literacy_report_web.pdf).
- 5) authors, All, and Brian W. Stone. "Teaching Visually Impaired College Students in Introductory Statistics." *Taylor & Francis*, <https://www.tandfonline.com/doi/full/10.1080/10691898.2019.1677199>.

- 6) "Literacy for Blind and Visually Impaired School-Age Students." *Re:View*, vol. 22, no. 3, Fall 1990, p. 159. EBSCOhost, [search.ebscohost.com/login.aspx?direct=true&db=asn&AN=9607211425&site=ehost-live](https://search.ebscohost.com/login.aspx?direct=true&db=asn&AN=9607211425&site=ehost-live).
- 7) Ye Wang, and Shariffa Khalid Qais Al-Said. "Defining Literacy for Individuals Who Are Blind or with Visual Impairments: A Qualitative Study of Stakeholders." *Journal of Ethnographic & Qualitative Research*, vol. 8, no. 2, Winter 2014, pp. 99–112. EBSCOhost, [search.ebscohost.com/login.aspx?direct=true&db=asn&AN=95101184&site=ehost-live](https://search.ebscohost.com/login.aspx?direct=true&db=asn&AN=95101184&site=ehost-live).
- 8) "Section 1414 (d) (3)." *Individuals with Disabilities Education Act*, 7 Nov. 2019, <https://sites.ed.gov/idea/statute-chapter-33/subchapter-ii/1414/d/3>.