SBraille: A Novel Method of Reading Braille

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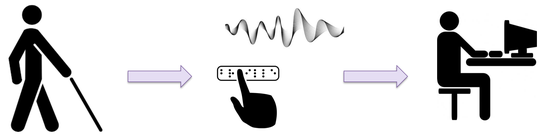
Scan to View Supporting Documents

Graphical Abstract



Visual impairments limit reading ability

Refreshable braille through vibration motors

Real-time braille display to read digital text

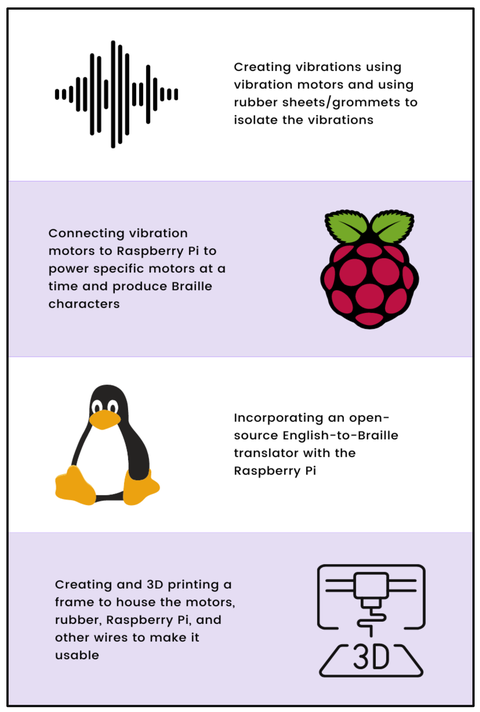
Background Information

12 Million people in the United States live with a visual impairment, out of which 1 million are completely blind (CDC, 2020).

145 Billion dollars is the annual economic impact for adults with a major vision problem, such as complete blindness (CDC, 2020)

70 Percent of survey respondents said that a loss of eyesight would have the greatest impact on daily activities (CDC, 2020)

Methodology



Phrase 1

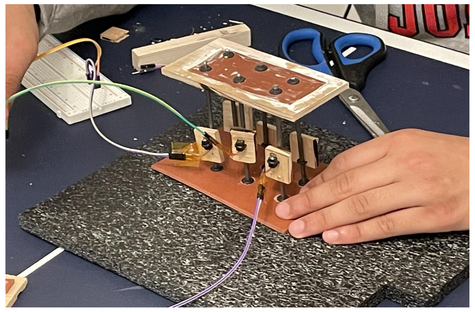
Blindness can correlate with a lower quality of life because an individual with a visual impairment has trouble reading digital text, especially since existing solutions are often inaccessible.

Phrase 2

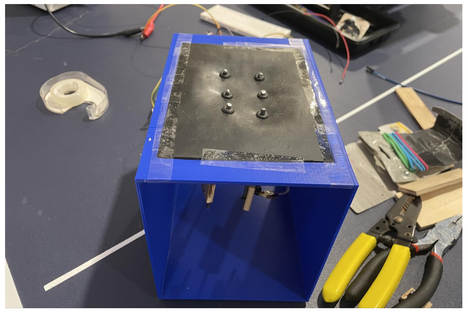
The goal of this project is to design and implement a cost-effective refreshable braille display that can convert digital English text into vibrating braille characters in real time.

Prototype 1

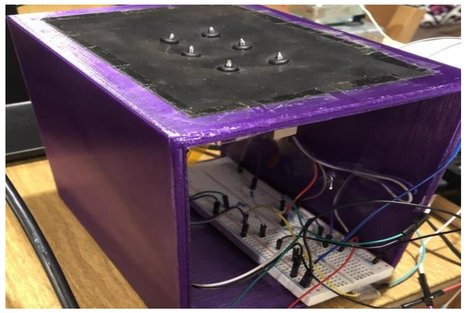
Prototype 2



Prototype 3



Prototype 4



Recognition Accuracy with Different Reading Methods

Table 1: Accuracy of system using one fingertip, one full finger, two fingers, and the full hand

Trial #	Fingertip	One Finger	Two Fingers	Whole Hand
Trial 1	5%	15%	35%	65%
Trial 2	5%	20%	30%	70%
Trial 3	0%	20%	40%	65%

Determining the Right Braille Reading Method for Users

Table 2: Accuracy of system using two fingers, two fingertips, and the full hand

Trial #	Two Fingers	Two Fingertips	Whole Hand
Trial 1	45%	85%	70%
Trial 2	40%	95%	70%
Trial 3	45%	100%	75%

Requirements Matrix

#	Requirement Type	Requirement	Level (1, 2, or 3)	Vibrating Module
1	Functional	A program to convert English to Grade 1 Braille	1	Yes
2	Functional	A method of displaying / producing braille (physical, vibration)	1	Yes
3	Functional	A link between the program and braille (hardware and software)	1	Yes
4	Functional	Vibration Design: Discernible vibrations (user can tell which nodes are vibrating)	1	Yes
5	Physical	Standard formatting: 2x3 grid with varying spacing	1	Yes
6	Cost	Unit cost: $100 / unit	1	Yes
7	Documentation	Documentation / manual written in a blind user-friendly form	1	Yes
8	User	User has a relatively keen sense of touch	1	Yes
9	User	User has access to compatible device (computer, tablet, etc.)	1	Maybe
10	Physical	Device weights under 2 pounds	1	Yes
11	Physical	Device fits on a standard tabletop	1	Yes
12	Cost	Unit cost: $30 / unit	2	No
13	Functional	Device takes input from a keyboard	2	Yes
14	Functional	Device reads input from a text document	2	Yes
15	Functional	Device operates without an internet connection	2	Yes
16	Physical	Device fits inside a square foot	2	Yes
17	Physical	All electronics are contained within device	2	Yes
18	Functional	Device reads data from formatted sources, converting to input	3	Yes
19	Functional	Device reads and translates non-dictionary words	3	No
20	Functional	Device takes digital input text wirelessly	3	No
21	Functional	Device scans input text from non-digital sources (paper, wall signs, etc.)	3	No
22	Functional	Device translates text into Grade 2 Braille	3	Yes

Conclusions

Pros:

- Vibrations are isolated
- Accurate input software

Cons:

- Bulky (pins are too far apart)
- Ideally should use screen reader instead of keyboard input

Next Steps

- Standardizing the size of all pins
- Increasing pin stability and vibration strength
- Incorporating transistors
- Running independently of keyboard
- Breadboard -> PCB
- Support of languages outside of English realm

References

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