Blindle

Creating Easily Accessible Reading Materials for the Visually Impaired

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Website

Demo

Introduction

- There are approximately 285 million people in the world that are visually impaired, with about 39 million who are legally blind.
  - With the growth of the aging population, low vision will become more of an issue.
- Braille reading materials are expensive to develop and purchase.
  - Braille is being taught less and less to those who would use it to read.
  - Text-to-audio is the most common form of "reading" for the visually impaired.

Problem Statement

- Current solutions for full page text are not portable and often cost around $2500.
- Solutions for fewer characters are confusing to keep track of longer words.
  - Single-character reader
  - 8-character reader

Figure 1. Existing braille e-reader. The device is expensive and too bulky to easily transport around.

Proposed Solution

- We will create a braille e-reader using electrotactile finger stimulation rather than actuators.
  - Smaller in size
  - Less delicate of a device

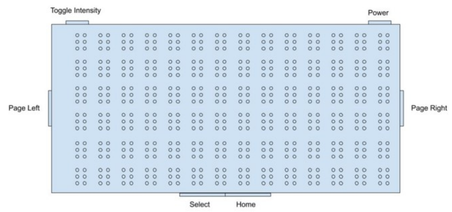

Figure 2. General design consisting of 6 buttons and a 6x14 array of braille cells utilizing electrotactile stimulation.

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Process

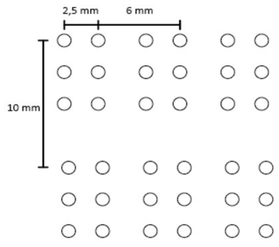

Figure 3. Format and spacing of braille characters.

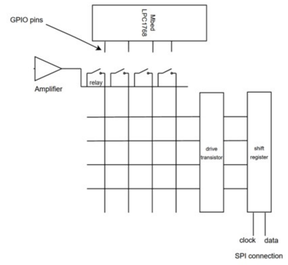

Figure 4. Signal select idea using shift registers to cycle through rows and columns.

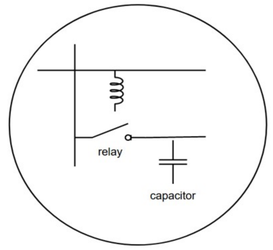

Figure 5. Electrotactile stimulation generation at a node using relays and capacitors.

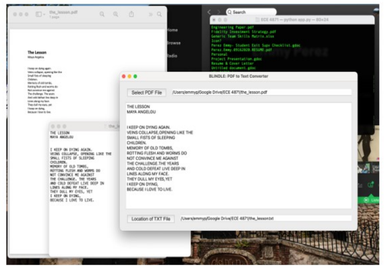

Figure 6. PDF to text translation necessary to read into device and then use a look up table to create a logical array of braille nodes.

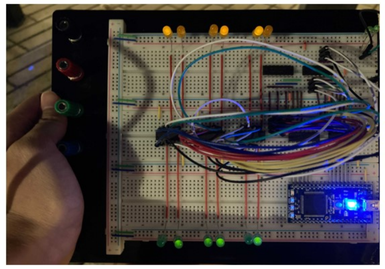

Figure 7. Breadboard with demux signal select of 2 braille cells using LEDs.

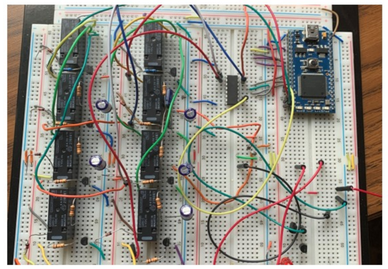

Figure 8. Breadboard with shift register signal select of a single braille cell using capacitors.

Prototype

Voltage	Person 1	Person 2	Person 3
50V	X	X	X
55V	X	X	X
60V	X	X	X
65V	X	X	X
70V	X	X	X
75V	Slight String	Slight Sting	X
80V	Strong Sting	Slight String	X
85V	Uncomfortable	Strong Sting	Slight Sting
90V	NA	Uncomfortable	Slight Sting
95V	NA	NA	Slight Sting
100V	NA	NA	Slight Sting

Figure 9. Voltage requirements to feel of sensation in the fingers of separate individuals.

- 2x4 braille cell array due to time and power constraints.
- Demux demonstrates the software while the shift register demonstrates the hardware.
  - Demux software would need to be integrated on the shift register design

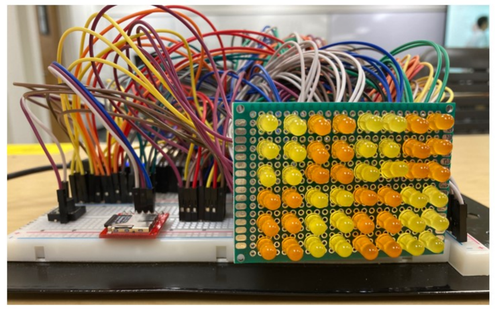

Figure 10. Breadboard display with demuxes to demonstrate software.

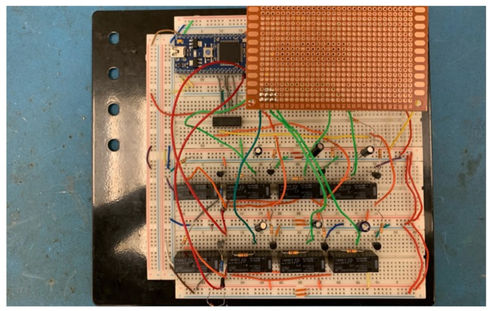

Figure 11. PCB with shift registers and capacitors to generate the electrotactile stimulation.

Conclusion

- Relays are space intensive which makes a compact design challenging.
  - A multi-layer board could potentially help
- Relays are loud and potentially annoying, especially if switched frequently.
  - Relays also degrade over time
- Takes roughly one second to charge the capacitors.
  - Could select smaller resistances that are capable of higher power dissipation to speed charging
- The sensation that the finger feels dulls out over time.
- High voltages are safe for humans, but conductive materials can cause large power dissipation.

Future Work

- Integrate software and hardware implementations.
- Decrease size of battery pack.
  - DC converters can step up small voltages at cost of potentially longer charging time
- Incorporate a user-friendly design.
  - Add the rest of the buttons navigate and potentiometer to toggle stimulation intensity
  - Develop a desktop application for book downloads

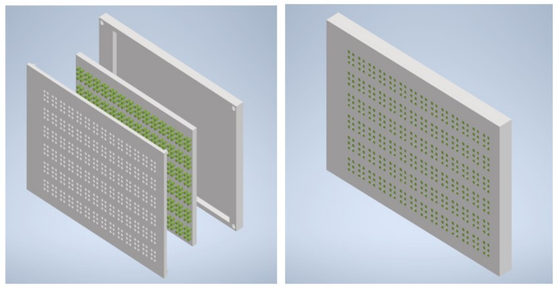

Figure 12. Final product design idea.

References

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