Braille Band: A Refreshable Braille Wristwatch

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Introduction

How does one tell the time of day without using sight and hearing? This is a challenge faced by many blind or visually impaired (BVI) individuals and deaf-blind individuals. While there does exist technology that utilizes audio, some form of braille, or vibration to communicate to the user the time of day; there is a lack of assistive devices that utilize refreshable braille coupled with vibrations to communicate time [1].

Goals/Motivations

- Propose a design for an affordable vibrating, refreshable braille wristwatch for BVI and deaf-blind individuals.
- Find an affordable alternative to piezoelectric braille cells
- Empower and increase independence of BVI and deaf-blind users
- Promote the use of braille

Design

Piezoelectric .vs. Solenoids

Piezoelectric actuators are currently both preferred for and common in refreshable braille displays [2]. The "compact size, lightweight, and direct-electrical control" are the primary reasons behind the commercial success of piezoelectric actuators [2]. However, piezoelectric actuators are costly and longitudinal in structure, making them less than ideal for hand-held or small braille devices [3]. Solenoids as an alternative add to the overall weight [3], but are much more cost efficient.

Current Design

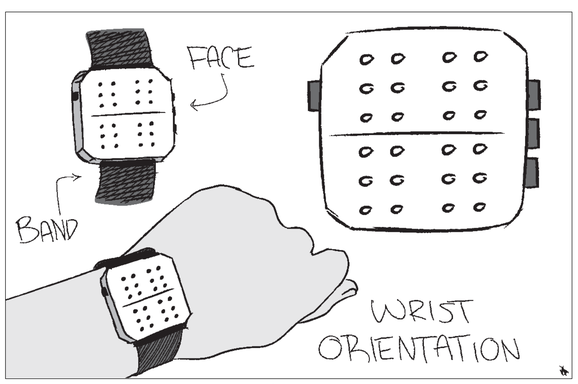

Illustration by [1c]Kenzie Armstrong

Features

- Multi-mode feedback (Braille-only, vibration-only, both)
- Hourly and half hour chimes (vibrations)
- Automatic time zone updates
- Alarm
- Timer

Prototype v1.0

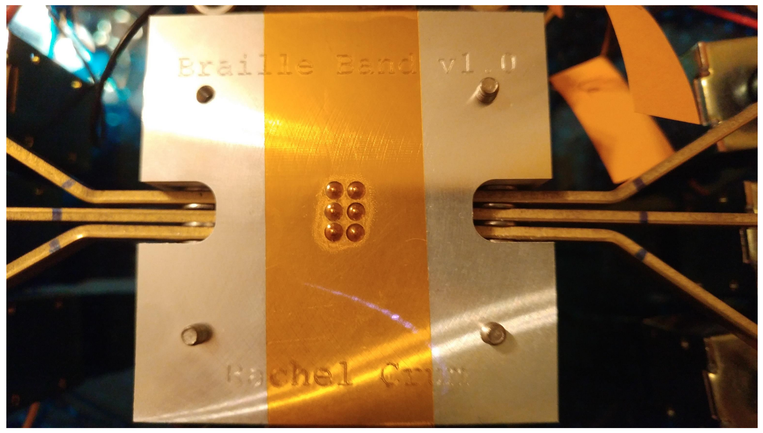

Photo by Rachel Crum

Materials

Below is a list of materials used in the prototype. The prototype was made possible by Darryl Levasseur and Joshua Hensley[1a, 1b].

Materials	Quantity
1K ohm Resistors	6
Arduino Uno R3 Microcontroller	1
TIP 110 Transistors	6
24V Power Supply at 1.25 Amps	1
Pontiac Coil Inc. Solenoid Pull Intermittent 24V	6
Breadboard	1

How it Works

The Arduino Uno is programmed to send 5V signals to the base of the TIP 110 transistor. The base then acts like a gate that closes the circuit and triggers the solenoid. This voltage is used to activate the appropriate solenoids to create any number (0-9) in braille.

Development

Software Development Life Cycle Model

The practice of incremental prototyping was prominent throughout the project. Braille Band v1.0 is the first of future prototypes to come and was utilized to establish the use of solenoid actuators in refreshable braille cells. The current software/code used in the project can be viewed as a prototype. Therefore, the **Prototyping Model** was selected as the Software Development Life Cycle Model for Braille Band [4].

Development Cycle

Below are highlights of the development cycle. Each phase is repeated and visited as necessary per prototype.

Research	Design	User Requirements	Execution
• Braille character standards • Current braille assistive technology • Assistive tech. design standards	• Size • Number of braille cells • Layout • Features, etc.	• Questions • Critiques • Expectations	• Implement prototype • Write, test, and implement code

Conclusion

The original goals of this project were to: propose a design for an affordable vibrating, refreshable braille wristwatch for BVI and deaf-blind individuals and to find an affordable alternative to piezoelectric braille cells. The current design based on user feedback does appeal to BVI users and proves to be a useful device [1d]. However, no feedback from possible deaf-blind users has been recorded. Solenoids used in this project were available at a fraction of the cost of a piezoelectric braille cell. The solenoids performed as expected with no time response deficiencies, however solenoids do contribute to the weight of the device tremendously given that for each individual braille dot there is a solenoid pushing it.

Future Work

- Miniaturize prototype
- Gather feedback from a wider variety of users (sex, age, etc.)
- Implement features

Acknowledgements

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References

1. Meteor deaf blind watch – black. http://www.lssproducts.com/product/Meteor-Deaf-Blind-Pocket-Watch-Black/deaf-blind-products. Accessed: 2017-04-19.
2. Pruittikorn Smithmaitrie. *Analysis and Design of Piezoelectric Braille Display.* INTECH Open Access Publisher, 2009.
3. Tinashe Harry Mubvuma. Alternative actuators for braille devices. 2014.
4. Software Development Life Cycle Models and Methodologies. (2016, December 06). https://melsatar.wordpress.com/2012/03/15/software-development-life-cycle-models-and-methodologies/. Accessed: 2017-04-19