Digital Braille Watch

Nick Anderson   Andrew Hanske   Nick Thate   Billy Zuleger

Client: Holly and Colton Albrecht   **Advisor**: Dennis Bahr[1]

[1]Department of Biomedical Engineering – University of Wisconsin-Madison

Abstract

The visually impaired rely on the Braille system to read and write. However, there isn't a current watch design that utilizes Braille. A watch of this type would allow the visually impaired to read the time accurately, discretely and efficiently. Current watch designs for the visually impaired include analog tactile watches and audio watches. However, the analog tactile watch is difficult to read and fragile, while the audio watch is disruptive and draws attention to the user.

The new design is a digital Braille watch, which rotates eight disks containing Braille dots in order to display the correct time. The final prototype was constructed and programmed with an Arduino Duemilanove USB board, eight servo motors, and various circuit elements. These components were then placed in an acroylonitrile-butadiene-styrene (ABS) case, which contained a display window through which the time could be read.

Initial testing was completed, confirming the benefits of the digital Braille watch design. Future work will consider minimizing size and power consumption, along with allowing visually impaired individuals to test our device.

Background

Braille Basics[1]
- Writing and reading method of the visually impaired
- Characters consist of three row by two column grid
- Varying combinations of dots signify different characters

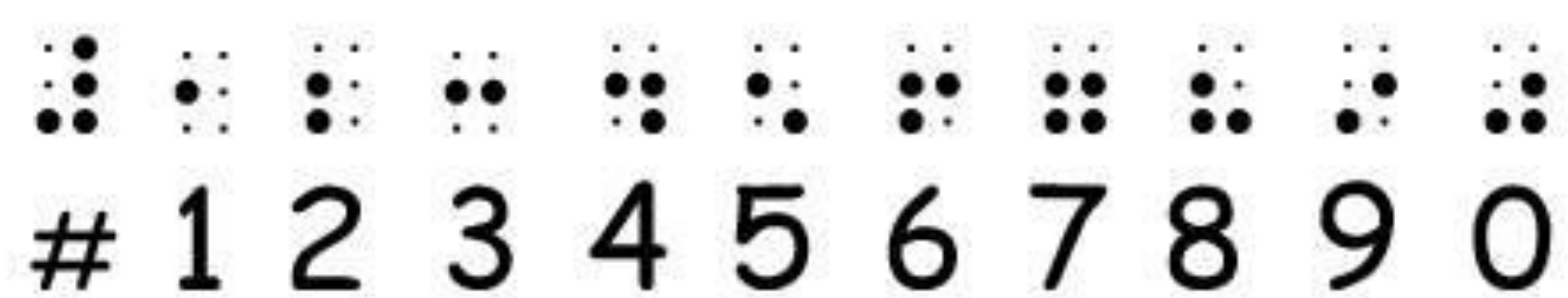**Braille Numerals** (Figure 1)

Figure 1: The Braille numbers 0-9 each consist of four dots

Image courtesy of Dotless Braille:
http://www.dotlessbraille.org/AboutBraille.htm

Motivation

- The visually impaired frequently rely on others to determine the time
- A well-designed watch would allow for increased independence
- Current watch designs for the visually impaired are ineffective

Goal: To create a digital Braille watch that allows the user to accurately and discretely check the time

References

[1] "Size and Spacing of Braille Characters." Braille Authority of North America. n.d. 27 Jan. 2010. <http://www.Brailleauthority.org/sizespacingofBraille/>.
[2] "Braille Watch". UW-Madison Biomedical Engineering Design Courses – Project Pages. 2008. 11 Feb. 2010. ArduinoBoardDuemilanove?action=diff>.
[3] "Haptica Braille Watch Concept". Tuvie Design of the Future. 2009. 25 Jan. 2010. <http://www.tuvie.com/haptica-Braille-watch-concept/>.
[4] "WWVB Radio Controlled Clocks." National Institute of Standards and Technology: Time and Frequency Division. 2010. 30 Mar. 2010. <http://tf.nist.gov/stations/radioclocks.htm >.

Final Design

Design Concept
- Eight disks containing Braille dots
- Disks rotate dots in and out of the display, forming the correct time

Features
- Powered by USB
- Configures to all zeros when initially connected to power
- Controlled by two buttons
  - Top button: Updates current mode
  - Bottom button: Changes mode
- Three modes
  - First mode: Hours and minutes
  - Second mode: Minutes and seconds
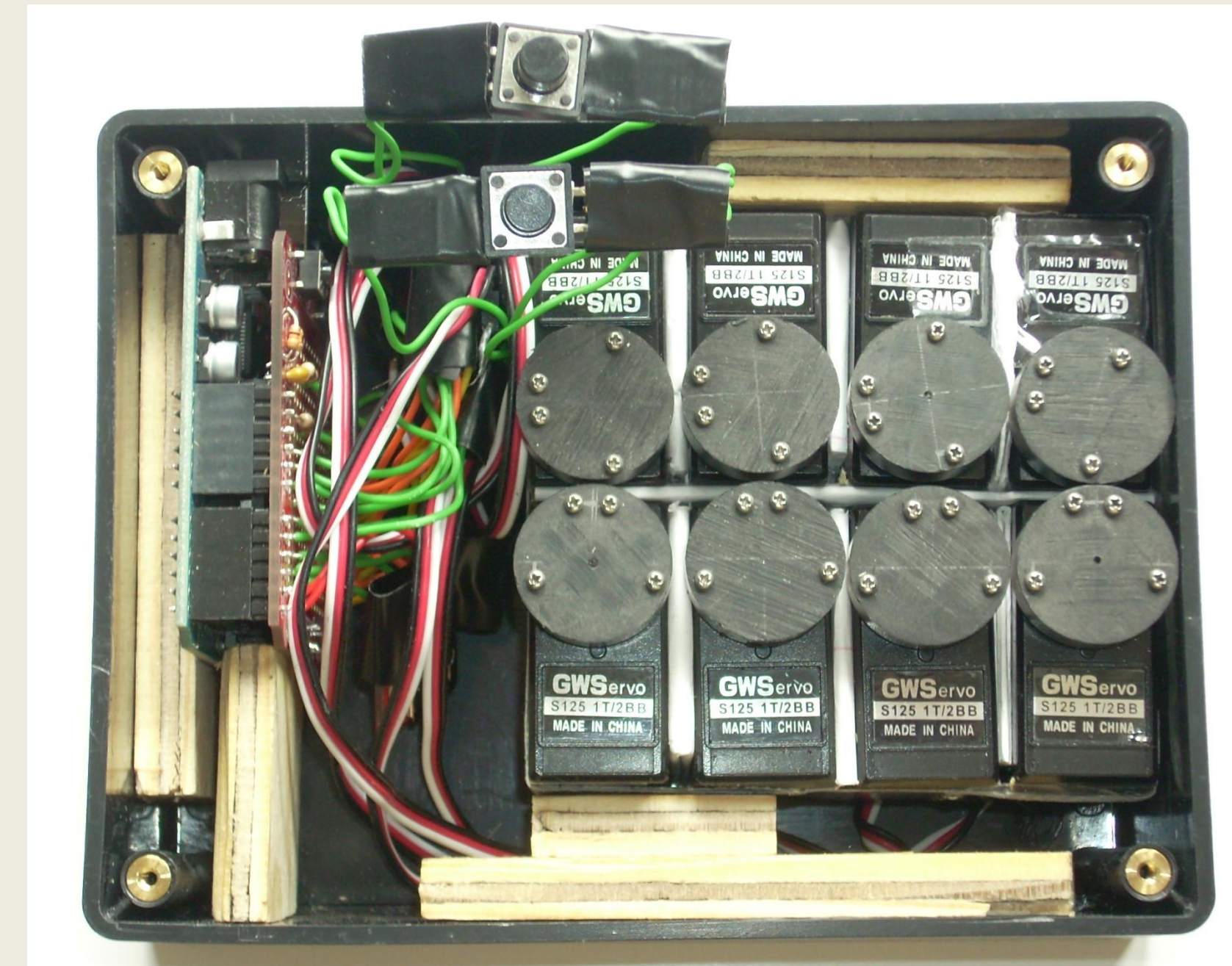 - Third mode: Month and day

Figure 2: Interior of the final prototype

Figure 3: An Arduino Duemilanove microcontroller programs the watch

Image courtesy of In Motion:
http://www.inmotion.pt/store/product_info.php?products_id=56

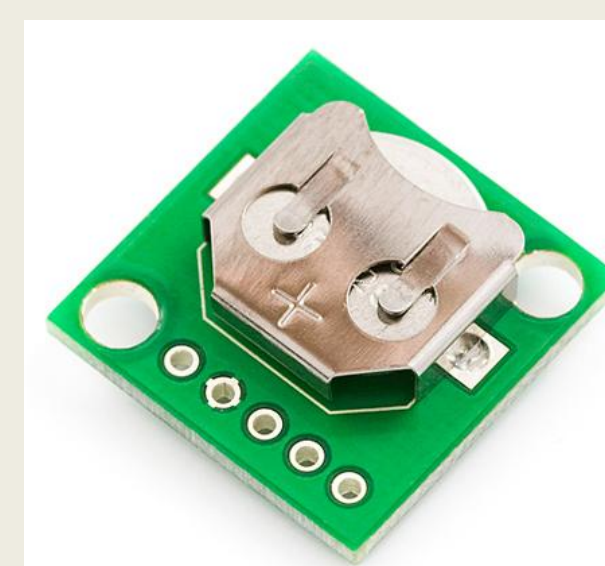*Figure 4*: A DS1307 Real Time Clock Module is used to communicate the time to the Arduino

Image courtesy of Active Robots:
http://www.active-robots.com/products/components/real-time-clock-module.shtml

Figure 5: High torque full turn GW servos are used to rotate the Braille disks

Image courtesy of Acroname Robotics:
http://www.acroname.com/robotics/parts/R298-1T-SERVO.html

Arduino Duemilanove (Figure 3)
- Microcontroller
- Reprogrammable
- Powered via USB or other external power supply (7-12 input voltage)

Real Time Clock Module (Figure 4)
- Reprogrammable
- Internal power supply
- Communicates time to Arduino

Servos (Figure 5)
- Controlled by Arduino
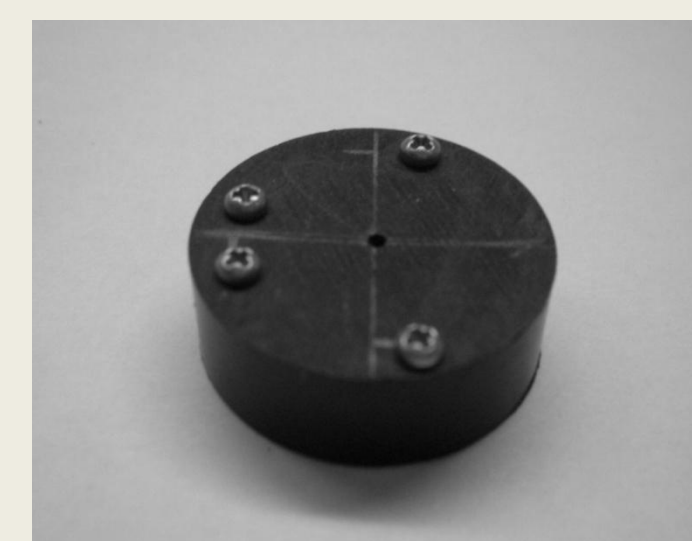- Produce 100 oz-in of torque
- Provide desired rotation

Figure 6: Braille disk used to configure the Braille numerals

Braille Disks (Figure 6 and Figure 7)
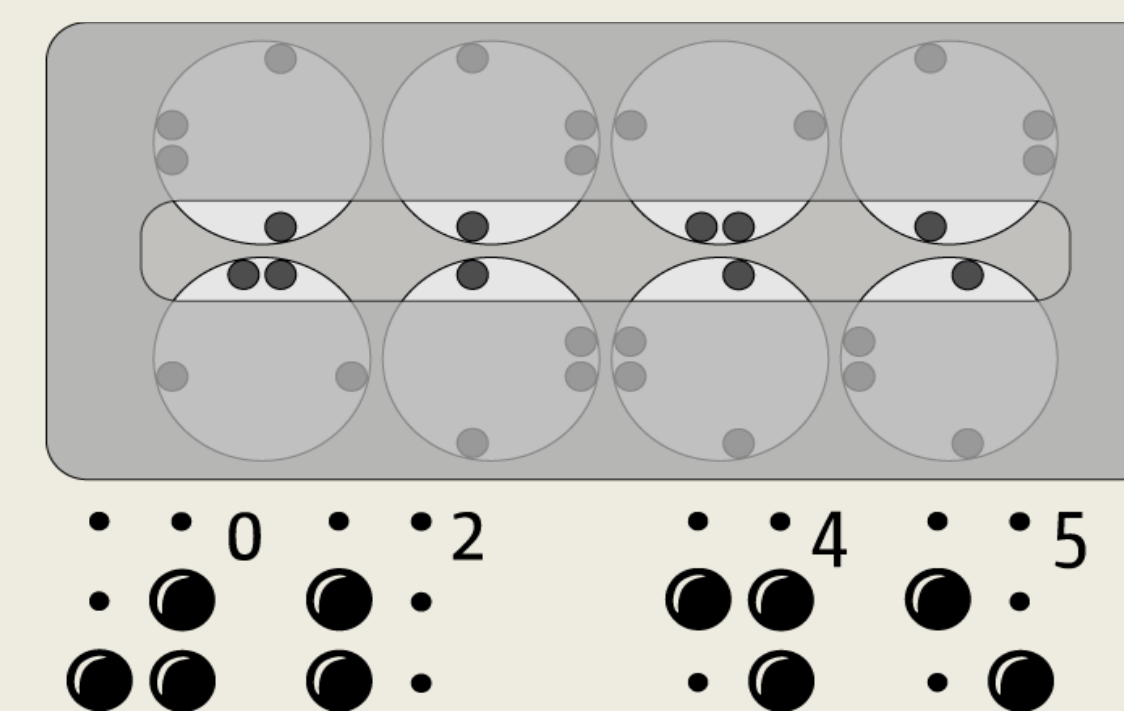- Cut from 7/8" plastic rod
- Four screws in each disk

Figure 7: The four dot disk design is used to display the correct time

Testing (Figure 8 and Figure 9)
- Surveyed visually impaired individuals
- All were familiar with the current devices
- 96% thought the date feature would be helpful
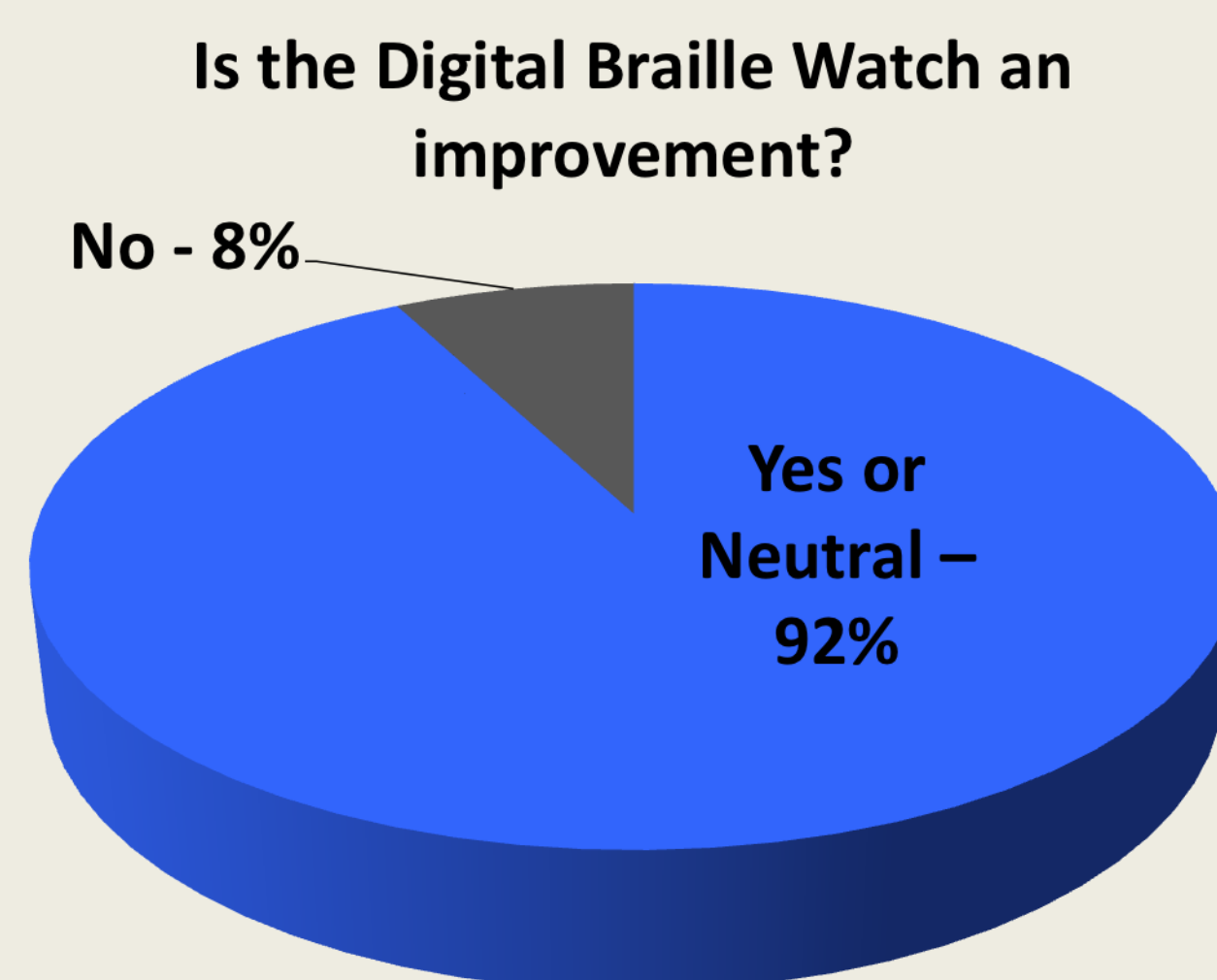- "I feel that a Braille Digital Watch would be a lot easier to use"

Is the Digital Braille Watch an improvement?

No - 8%
Yes or Neutral – 92%

Figure 8: The survey results demonstrate that the Digital Braille Watch is an improvement upon the current devices

I would recommend using the Digital Braille Watch.
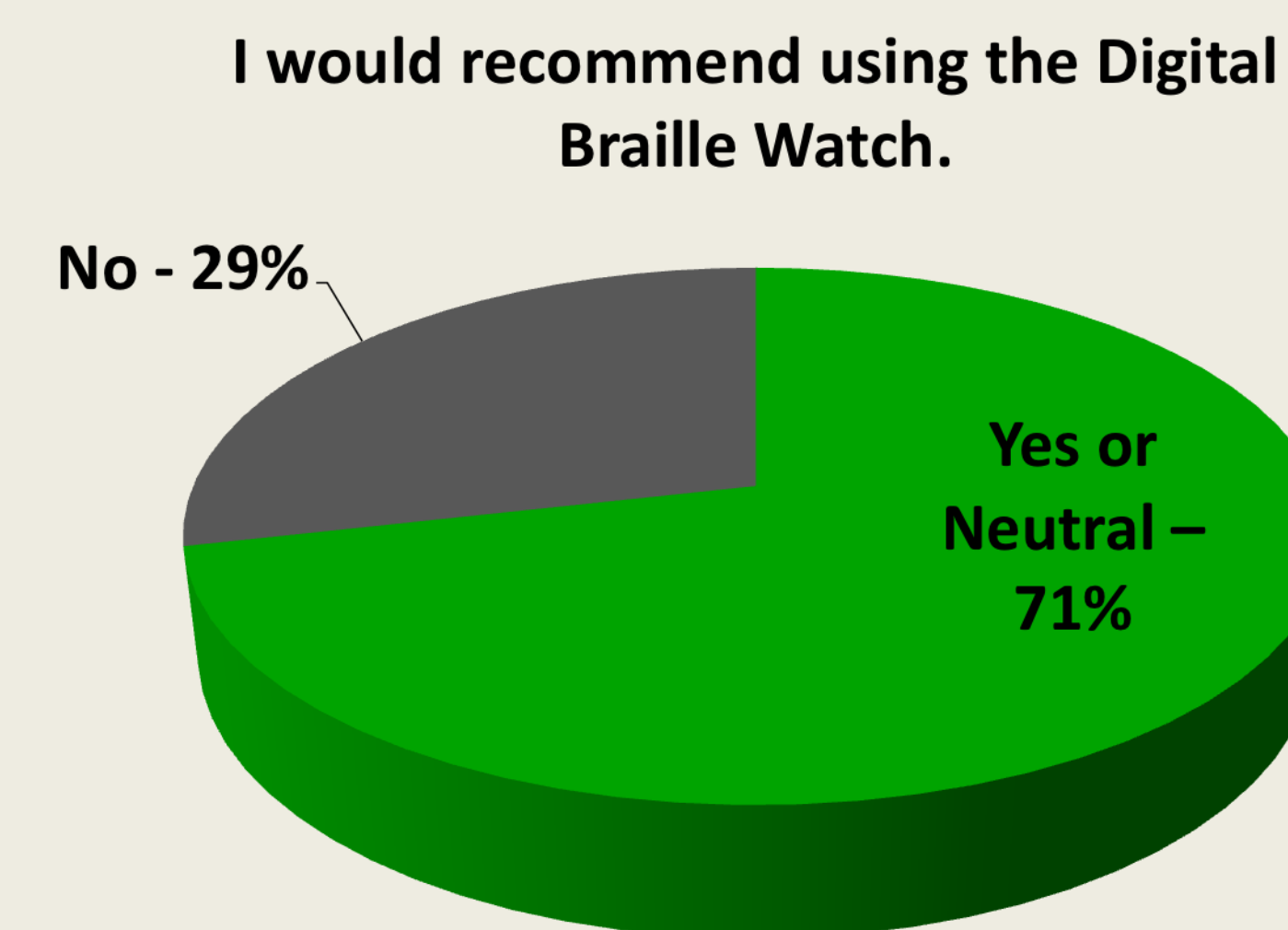

No - 29%
Yes or Neutral – 71%

Figure 9: The survey results show that visually impaired individuals would recommend using the Digital Braille Watch over the existing devices

Design Criteria

Client Requirements
- Display military time
- Silent and without vibrations
- Improve on previous BME designs[2] (Figure 10)
- Time displayed in standard Braille

Functionality
- Accurate and reliable
- User-friendly

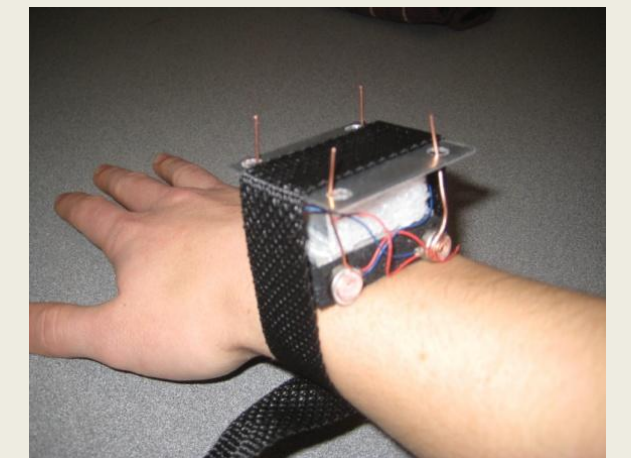**Additional Specifications**
- Aesthetically pleasing
- Safe

Figure 10: Vibrating dots prototype created by past BME design team

Image courtesy of BME 200 Fall 2008 Digital Braille Watch Team:
http://homepages.cae.wisc.edu/~bme300/braille_watch_f08/secure/

Competition

Audible Watch (Figure 11)
- Audibly communicates the time
- Disruptive

Figure 11: The Audible Watch announces the time to the user when prompted

Image courtesy of Tel-Time:
http://ecx.images-amazon.com/images/I/41hK4nPAzL._SL500_AA280_.jpg

Analog Tactile Watch (Figure 12)
- Similar to standard analog watch
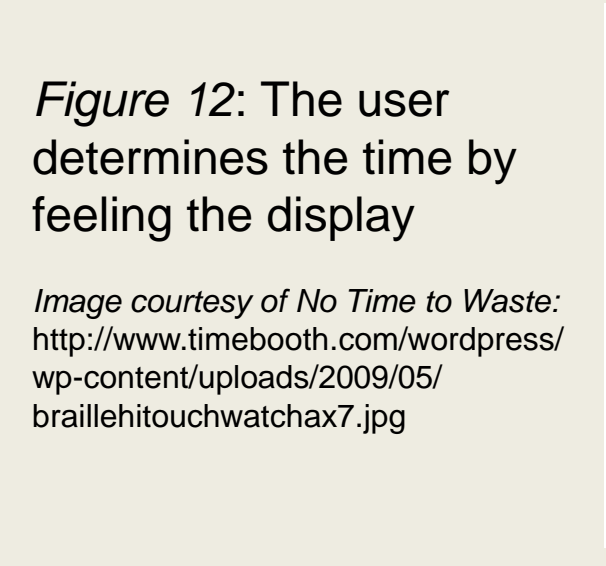- Difficult to read
- Fragile

Figure 12: The user determines the time by feeling the display

Image courtesy of No Time to Waste:
http://www.timebooth.com/wordpress/wp-content/uploads/2009/05/braillehitouchwatchax7.jpg

Haptica Braille Watch[3] (Figure 13)
- Designed by David Chavez
- Individual dots move in and out of display to form Braille numerals
- Just a design; no mechanism

Figure 13: Sixteen disks rotate to display the time

Image courtesy of Tuvie Design of the Future:
http://www.tuvie.com/haptica-braille-watch-concept/

Future Work

Design Optimization
- Lower power consumption
- Built-in power supply
- Add additional features
- WWVB radio control[4]
- Adapt for mass production

Minimize Size
- Replace servos with smaller rotating mechanism
- Eliminate microprocessor
- Make wristwatch-size

Further Testing
- Receive more feedback
- Allow people to test the watch

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- Holly Albrecht