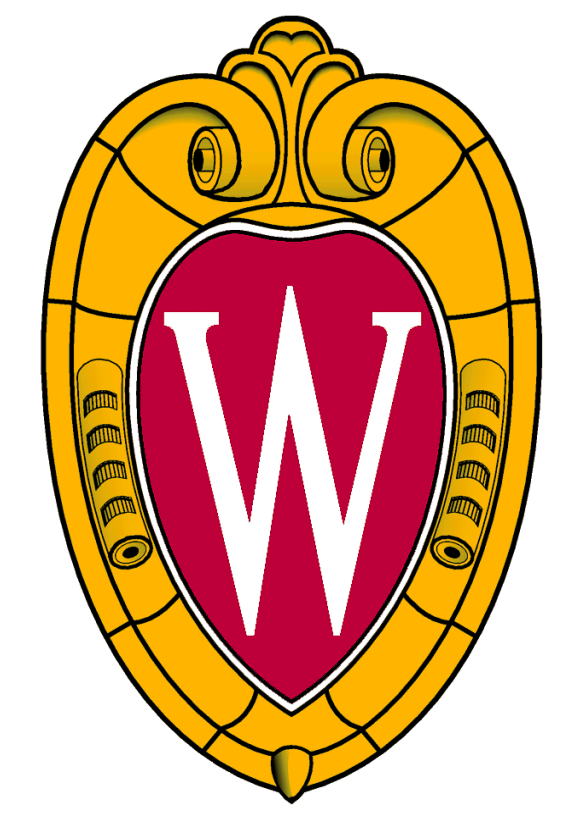




# Digital Braille Watch



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## Abstract

The Braille language is the primary means of communication by those with a visual impairment, yet no device exists that utilizes Braille to tell time. Currently, the visually impaired must rely on tactile or talking watches. However, tactile watches are difficult to read, while talking watches are disruptive. Since the current methods are inadequate, a Digital Braille Watch was designed.

The final prototype uses four rotating disks, each positioned beneath four pins. By rotating a total of 165 degrees, these disks can raise and lower the pins to form all ten numerals in the Braille number system. The prototype was constructed using a microcontroller, four servo motors, four disks, and sixteen pins and springs. All of these were enclosed in an acrylonitrile-butadiene-styrene (ABS) case, which effectively compartmentalizes the various components.

Initial testing was completed, confirming the benefits of our Digital Braille Watch Design. Future work will involve further minimizing the size of our prototype and looking for alternative power sources.

## Background

### Braille Basics<sup>[1]</sup>

- Method of written communication used by the visually impaired
- Numerical characters use a two-by-two grid
- Using different combinations of raised or lowered dots, all ten numbers can be displayed

### Braille Numerals (Figure 1)

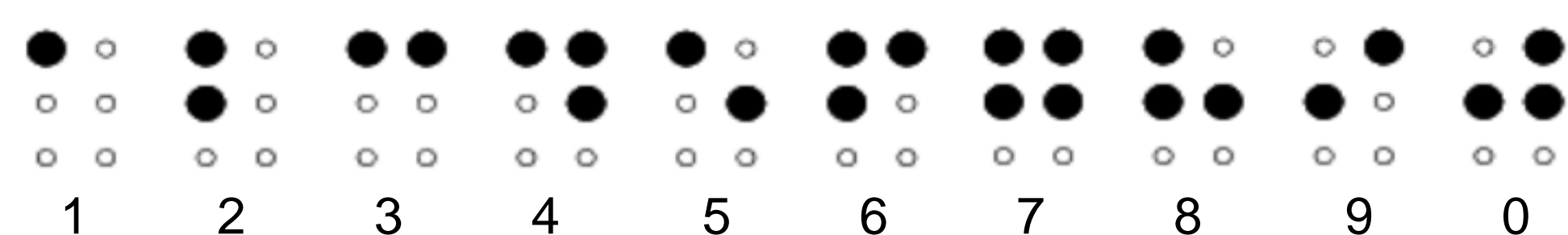


Figure 1: The Braille numbers 0-9 each consist of four dots  
<http://www.dotlessbraille.org/AboutBraille.htm>

## Motivation

- The visually impaired frequently rely on others to determine the time
- A well-designed watch would allow for more independence
- Current watch designs for the visually impaired are disruptive and 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](http://www.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/>>.

## Final Design

### Design Concept (Figure 3)

- Four rotating disks located beneath watch surface, one for each Braille digit
- Each disk has raised and recessed surfaces, which raise and lower pins creating desired number

### Features

- Programmed using Arduino
- Uses Real Time Clock Module
- Many components manufactured using three-dimensional printer
- Three modes
  - First mode: Hours and minutes
  - Second mode: Minutes and seconds
  - Third mode: Month and day

- Raised Surface
- Recessed Surface
- Braille Pin

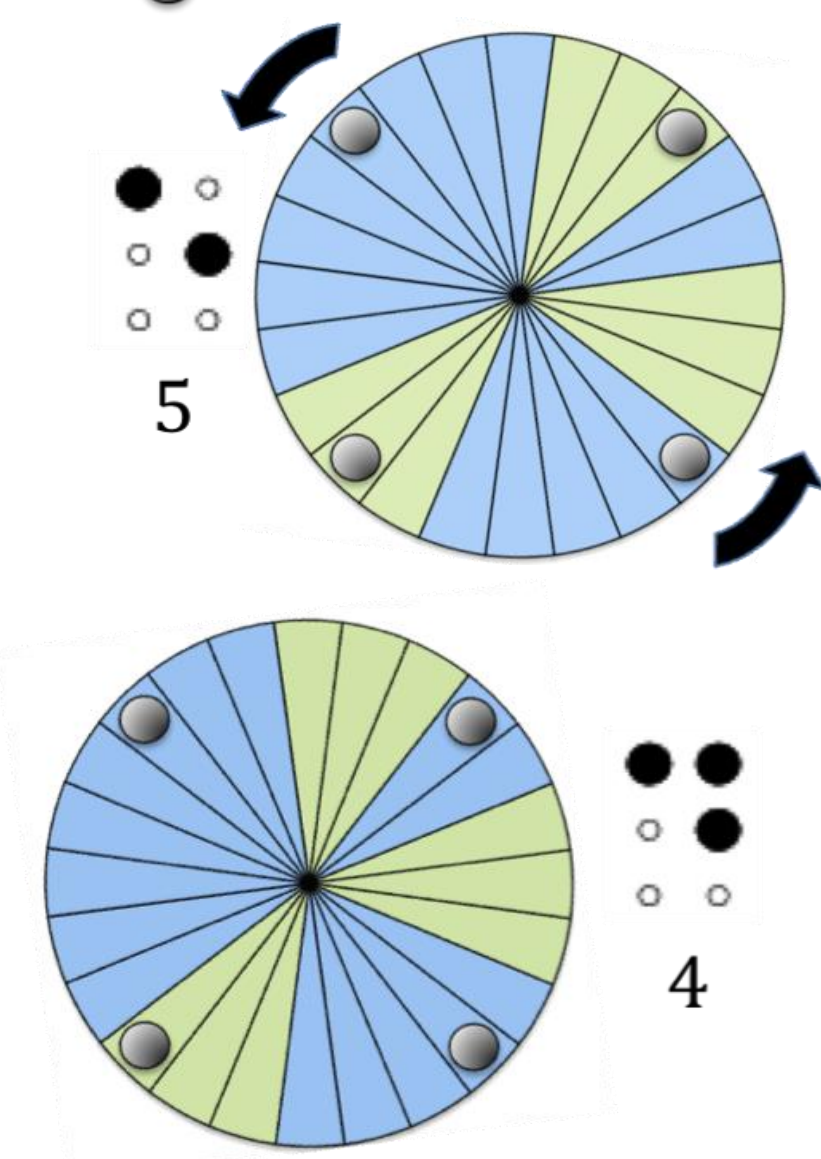


Figure 3: The raised and recessed surfaces on the disk cause different numbers to be displayed



Figure 4: The rotating disks machined from ABS plastic

### Disks (Figure 4)

- Control pin elevation
- Reduce power requirement

### Servos (Figure 5)

- Controlled with Arduino
- Provide desired rotation

### Pins (Figure 6)

- Serve as Braille dots
- Supported by compression spring

### Casing (Figure 2)

- Composed of three elements
- Specialized compartments allow for easy assembly

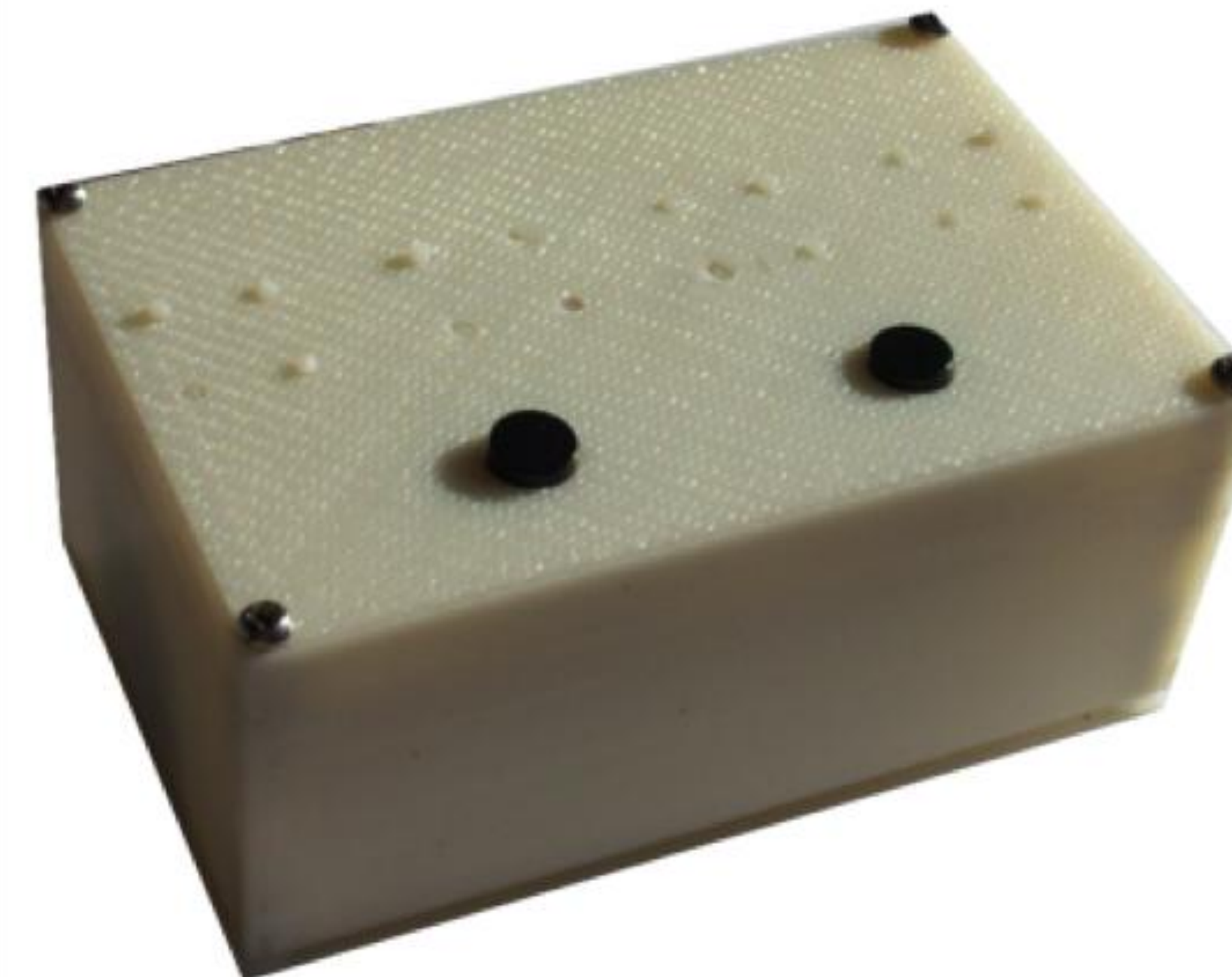


Figure 2: Fully assembled Digital Braille Watch displaying the numbers 41:47

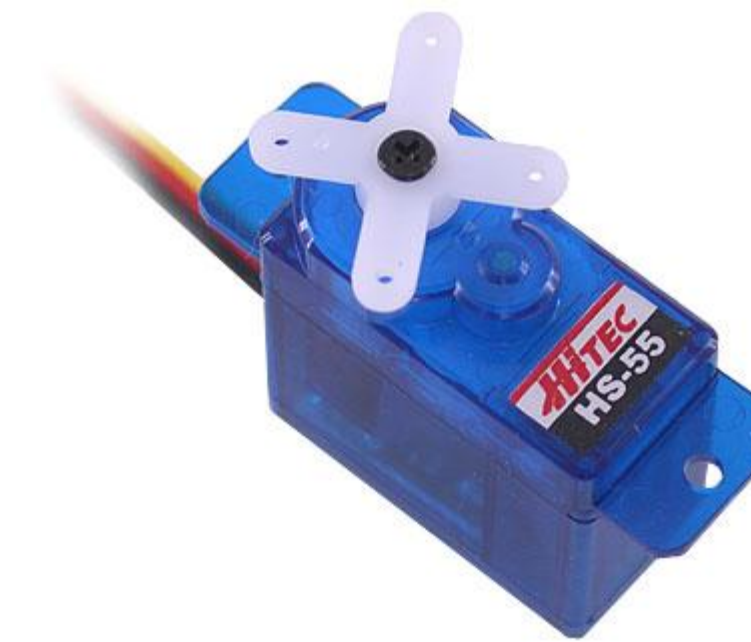


Figure 5: The servos used in our design

Image courtesy of ServoCity  
[http://www.servocity.com/html/hb-55\\_sub-micro.html](http://www.servocity.com/html/hb-55_sub-micro.html)



Figure 6: Each Braille pin is held in place using a compression spring

### Testing (Figure 7 and Figure 8)

- 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"

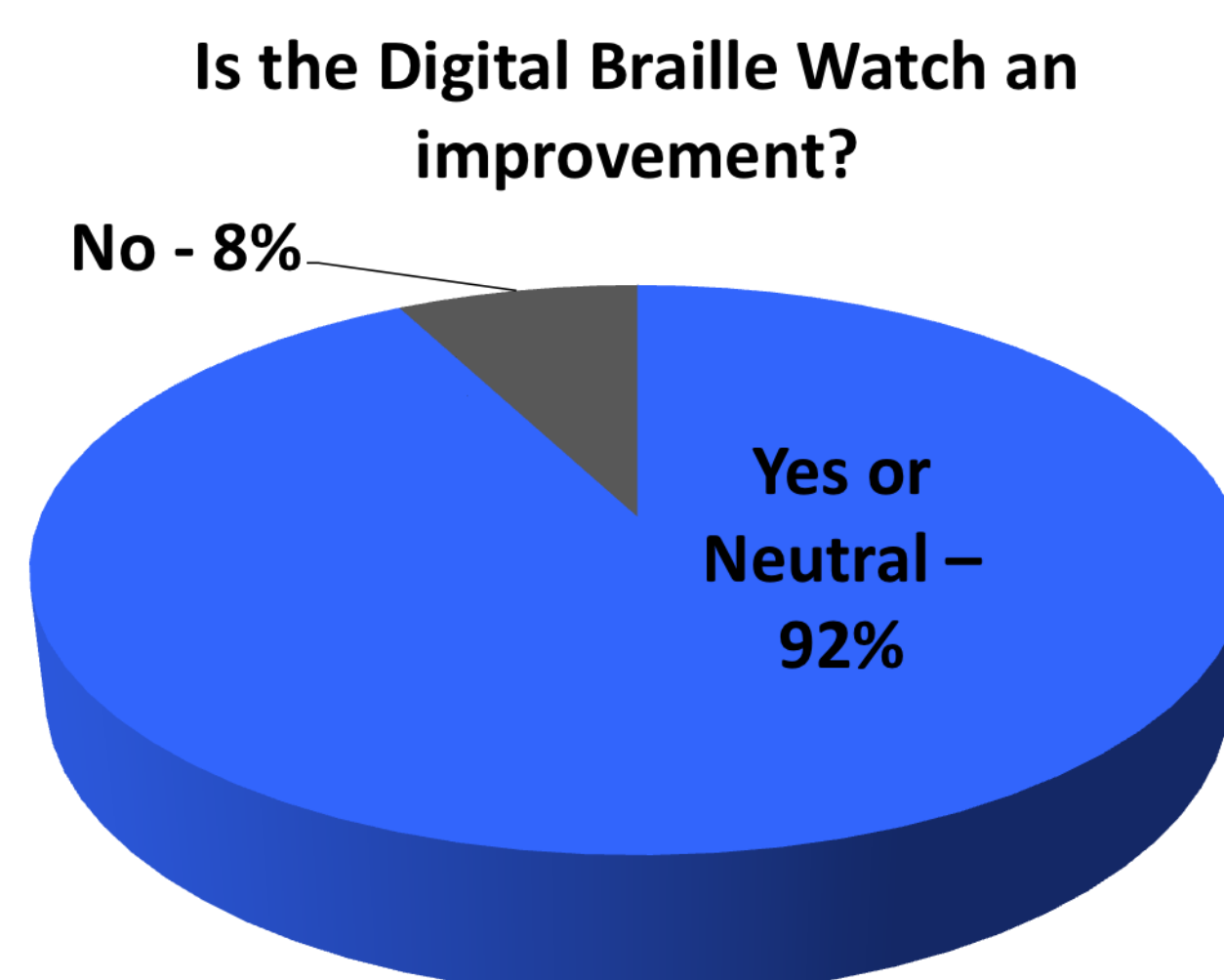


Figure 7: The survey results demonstrate that the Digital Braille Watch is an improvement upon the current devices

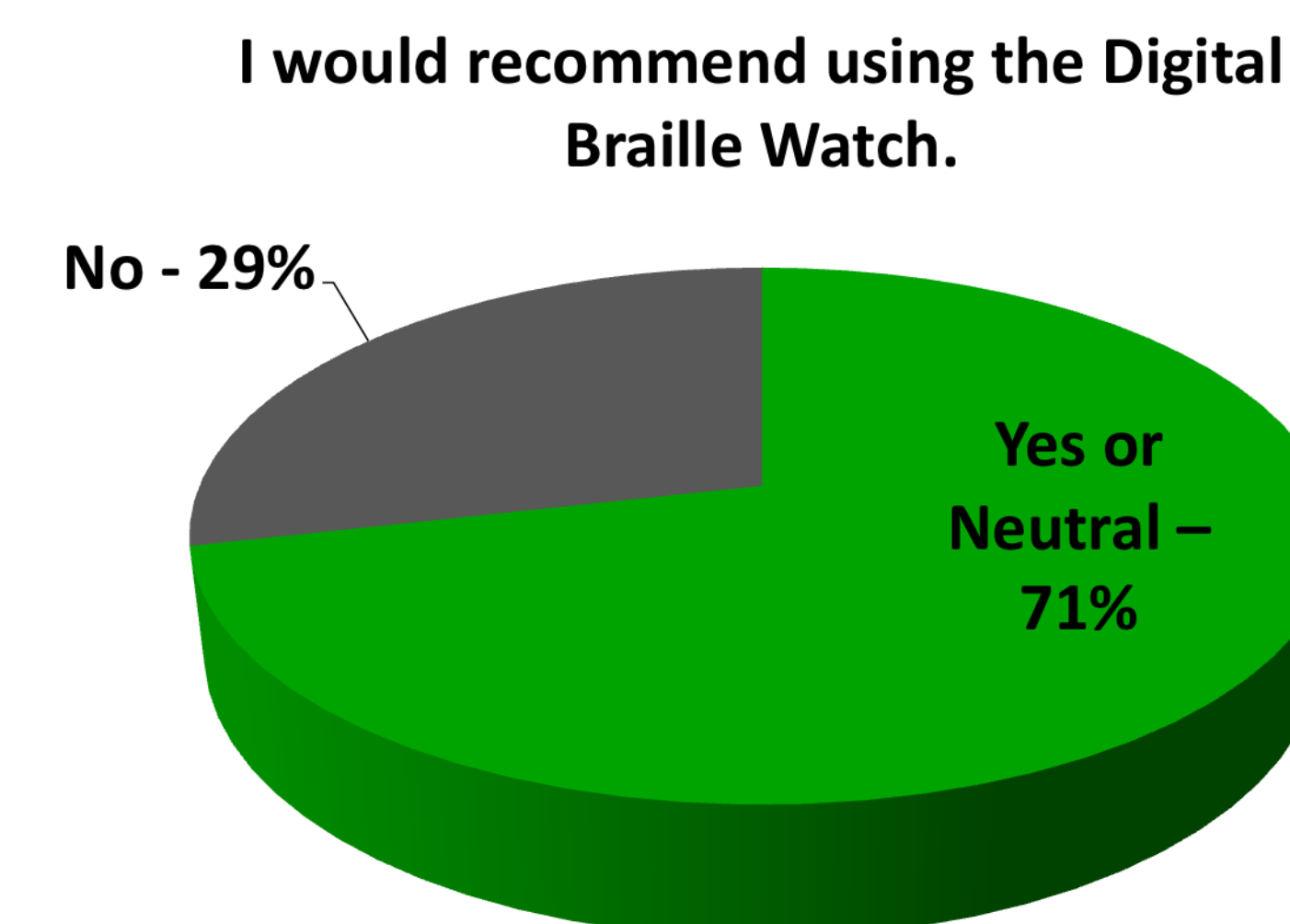


Figure 8: The survey results show that visually impaired individuals would recommend using the Digital Braille Watch over the existing devices

## Design Criteria

### Client Requirements

- Display military time
- Silent and without vibrations
- Improve on previous BME designs<sup>[2]</sup> (Figure 9)
- Time displayed in standard Braille

### Functionality

- Accurate and reliable
- User-friendly

### Additional Specifications

- Aesthetically pleasing
- Safe

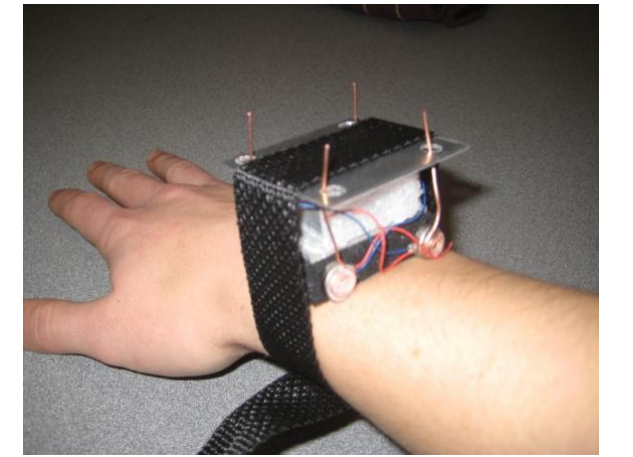


Figure 9: Vibrating dots prototype created by past BME design team

Image courtesy of BME 200 Fall 2008  
Digital Braille Watch Team:  
[http://homepages.cae.wisc.edu/~bme300/braille\\_watch\\_f08/secure/](http://homepages.cae.wisc.edu/~bme300/braille_watch_f08/secure/)

## Competition

### Audible Watch (Figure 10)

- Audibly communicates the time
- Disruptive



Figure 10: The Audible Watch announces the time to the user when prompted

Image courtesy of Tel-Time:  
[http://ecx.images-amazon.com/images/I/41hK4nPA-zL\\_SL500\\_AA280.jpg](http://ecx.images-amazon.com/images/I/41hK4nPA-zL_SL500_AA280.jpg)

### Analog Tactile Watch (Figure 11)

- Similar to standard analog watch
- Difficult to read
- Fragile

Figure 11: 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/brailletouch-watchx7.jpg>



### Haptica Braille Watch<sup>[3]</sup> (Figure 12)

- Designed by David Chavez
- Individual dots move in and out of display to form Braille numerals
- Just a design; no mechanism



Figure 12: 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

### Size Reduction

- Use smaller servos with a gear mechanism
- Smaller, more efficient power source
- Custom parts

### Testing

- Observe functionality over a longer period of time
- Get user feedback

### Optimization

- Rechargeable battery
- Radio-controlled time
- Components suited for mass production

## Acknowledgements

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