



# Digital Braille Watch



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## Abstract

The Braille system is the primary reading and writing method for 284 million blind individuals worldwide, yet no device exists that utilizes Braille to indicate time. Currently, the visually impaired 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. Each disk contains raised and lowered surfaces which dictate the pin orientation. Based on the arrangement of raised and lowered pins, the corresponding Braille numeral can be felt on the surface of the watch. The four disks are integrated with a gear system, allowing the watch to be controlled via the constant rotation of one disk.

Future work includes adding a rotating mechanism as well as manufacturing the watch with metal parts, thereby increasing the watch's durability and decreasing its size. Furthermore, completing a fully functional prototype and earning the interest of companies would allow for the advancement of the Braille watch into a buyer market.

## 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
- Size standards – dots at least 2.34 mm. apart, 0.48 mm. in height, characters 6.22 mm. apart

### Braille Numerals (Figure 1)

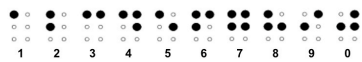


Figure 1: The Braille numbers 0-9 each consist of four dots  
<http://www.scribd.com/doc/10040404/Braille>

## Motivation

- The visually impaired frequently rely on others to tell time
- A well-designed watch would allow for more independence
- Current watch designs for the visually impaired are disruptive and challenging to read
- There is currently no watch that displays the time in Braille

**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] "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

- Four rotating disks are located beneath watch surface, one for each Braille digit (Figure 2)
- Each disk has raised and recessed surfaces, which raise and lower pins (Figure 3) creating desired number
- Disks interact via integrated gears
- Overlapping the disks allows for standard spacing

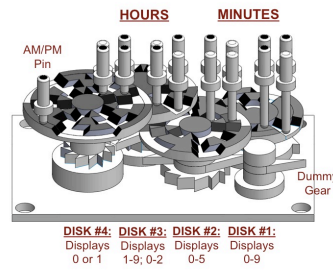
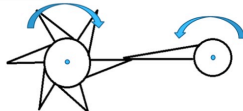


Figure 2: By designing four disks with the appropriate raised and lowered surfaces, pins can be correspondingly raised and lowered in order to display the correct time

### Features

- Manufactured using Viper si2 SLA printer (precision = 0.051 mm.)
- 12-hour watch with AM/PM indicator pin (up = PM)
- Rotating the dummy gear once per minute will control the entire watch (Figure 4)
- Standard Braille spacing

### TOP VIEW

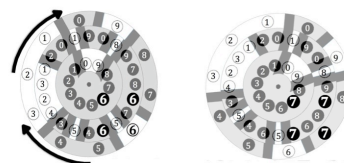


### SIDE VIEW



Figure 4: A full rotation of a long gear leads to a partial rotation of a shorter gear, thus allowing the disks to rotate in increments rather than continuously

### TOP VIEW



### SIDE VIEW

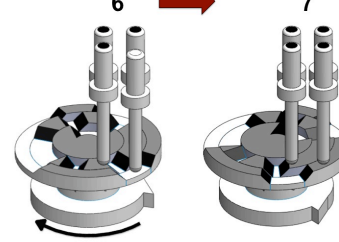


Figure 3: The raised and recessed surfaces on the disk cause the numbers 0-9 to be displayed as the disk rotates clockwise

### Testing

- Volunteers from the Wisconsin School for the Visually Impaired provided feedback on the prototype (Figure 5)
- Spacing was ideal, easy to read
- Diverse market – blind, elderly, military
- Necessity for product exists



Figure 5: Final Braille Watch assembly displaying the time 09:16 PM

## Design Criteria

### Client Requirements

- Size of a standard wristwatch
- Silent and without vibrations
- Standard Braille numbering and spacing
- Self-contained power supply
- Improve on previous designs (Figure 6,7)

### Functionality

- Accurate and reliable
- User-friendly

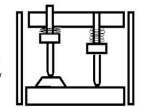
### Additional Specifications

- Aesthetically pleasing
- Safe and durable

Figure 6: Fall 2010 fully assembled Digital Braille Watch



Figure 7: Fall 2010 design shows spring mechanism that keeps pins below watch surface



## Competition

### Talking Watch (Figure 8)

- Audibly communicates the time
- Disruptive



Figure 8: The Talking Watch announces the time to the user when prompted

### Tactile Watch (Figure 9)

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



Figure 9: The user determines the time by feeling the display

### Haptica Braille Watch<sup>[2]</sup>

- Designed by David Chavez
- Just a design; no mechanism

## Future Work

### Incorporate Rotating Mechanism

- Requirements
  - Fits inside current design
  - Power efficient
  - Applies necessary torque
- Discuss possibilities with watchmaker

### Manufacture Parts (Figure 10)

- Various options – CNC Milling most likely
- Disks must be broken into and manufactured as separate parts, then reassembled
- Will provide durable and accurate parts

### Test Prototype

- Complete and verify force calculations
- Perform long-term trials to test accuracy

### Further Considerations

- Gain company interest
- Market final product



Figure 10: Local prototyping company, Tosa Tool, has CNC milling with 0.007 mm. precision  
<http://www.tosatool.com/askaboutproducts/fut9600-cnc-milling.jpg>

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