RESNA

Student Design Competition

AlphaBraille (University of North Carolina at Chapel Hill)

by Resna1238sdc on MAY 31, 2012 in TECH FOR COGNITIVE & SENSORY IMPAIRMENTS {EDIT}

AlphaBraille

Seong-Hee Yoon, Lina Carballo, Quetrell Heyward

ABSTRACT

Studies have shown that learning Braille expands the educational and employment opportunities of individuals with visual impairments (1). Our client Stephanie would like to learn Braille, but she does not have a toy that can help her to accomplish this task. The goal of this project was to design and build an engaging, portable device that encourages Stephanie to learn the Braille alphabet. AlphaBraille provides the texture, name, dot numbers, and phonics associated with each character. Stephanie can use AlphaBraille without supervision, and this device will help her to associate catchy songs with each letter.

INTRODUCTION/BACKGROUND

Stephanie is a five year old girl who was diagnosed with Retinopathy of Prematurity (ROP) at birth. As a result, she has no visual perception with the exception of distinguishing between dark and light environments. In addition, she has cognitive delays due to her premature birth that result in difficulties paying attention, carrying out specific tasks, and lifting certain objects (2, 3).

Braille literacy enables people with visual impairments to read and write. Mastering Braille is especially challenging for children (4). Memorizing the alphabet requires spatial perception, an acute sense of touch, and learning several dot combinations. While there are several fun and stimulating games that teach phonics to children with vision, toys that teach Braille to children with visual impairments are scarce. Teachers usually have plastic sheets with Braille textures and practice reading them with their students. Because Braille sheets do not provide feedback motivation, children struggle to remain focused on the Braille letters for extended periods of time. Although teachers are very helpful in engaging children, children do not have a way to practice reading Braille outside of their school.

PROJECT GOALS

The goal of this project was to design and manufacture a portable and washable electronic device that will help Stephanie learn Braille and phonics. This device features the textures of the full Braille alphabet and a melodic description of each character. The product encourages the user to learn Braille and phonics. AlphaBraille provides audio and tactile feedback. Also, it promotes a fun and engaging environment where young students can learn. Parents and teachers can easily set the volume and replace the batteries.

DESIGN AND DEVELOPMENT

Overview

AlphaBraille consists of twenty-six semi-circular pieces with Braille characters and a base with an opening that matches the shape of the puzzle pieces. To play with the device, the user selects a puzzle piece and inserts it into the top of the base, which contains electronic components. This prompts AlphaBraille to play a song about that Braille character. The song includes the letter's name, phonics, dot numbers, a sample word, and a sound that represents the word. Next, the user removes the puzzle piece and inserts a new one into the base. Kids can repeat this process multiple times to become familiar with the alphabet or to test their knowledge while having fun in the process.

Detailed Descriptions

Puzzle Piece

The puzzle pieces were designed and fabricated using computer software and a 3-D printer. As mentioned above, each piece contains a Braille configuration on its top surface that represents a certain letter of the alphabet. The bottom of each piece contains a set of holes that will activate a unique combination of the push-buttons located on the top surface of the base containing the device's circuitry. For example, if the user inserts puzzle piece "G" then switches #1, 2, and 3 will be activated; meanwhile, if the user inserts puzzle piece "S" then switches #1, 2, and 5 will be activated. An illustration representing how the user will insert the puzzle piece into the base and activate the appropriate buttons is shown in Figure 1.

Figure 1. Illustration showing how a puzzle piece is inserted into the base

Electronic Components

A microcontroller acts like a computer because it translates pressed push-buttons into the appropriate sound files. It controls the Rogue Robotics µMP3 Player (5), which stores and plays twenty-six MP3 files corresponding to the letters of the alphabet. For instance, if the microcontroller receives signals from the puzzle piece "B," it sends an electronic message to the µMP3 Player to play the "B" song. A voltage divider that is accessible to the user serves the dual purpose of preparing the signal for the audio amplifier circuit and providing volume control. After the amplifier magnifies the output of the µMP3 Player, a mini-speaker transmits it to the user. The overall process of the device's function is depicted in Figure 2.

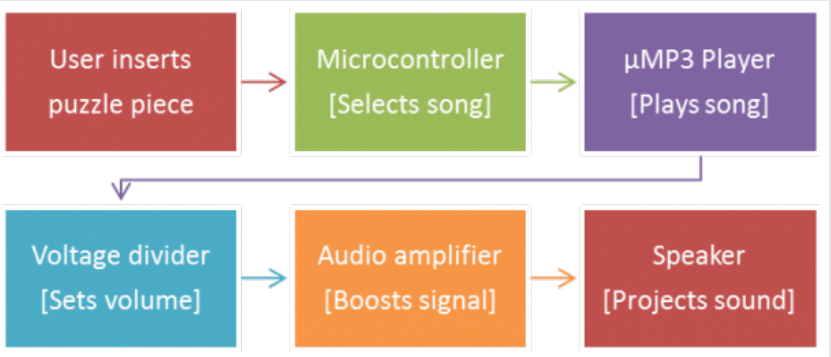

Figure 2. Flowchart describing the final product

EVALUATION

The device was evaluated to assess durability, client and staff ease of use, accurate functionality, and safety. Durability was assessed by testing what would happen if the client dropped the device. The puzzle pieces as well as the base were dropped onto a semi-hard surface, and all components withstood the impact. Ease of use was assessed through observation. Stephanie enjoyed playing with the device and did not need detailed instructions. She was able to correctly insert the puzzle piece into the base and to activate the corresponding tune. A target of 90% accuracy was established. For each letter, twelve trials were conducted to test the accuracy of the interaction between the puzzle and the base. Overall, the correct song was played in 97% of the trials. A hazard analysis was conducted, and risks were identified and addressed in the final design. A Braille instructor assessed the device and approved its delivery to the client.

DISCUSSION AND CONCLUSIONS

AlphaBraille is a powerful tool for parents and teachers helping kids to learn Braille. Resembling current methods, our device teaches Braille to children by familiarizing them with Braille textures. However, our device takes teaching a step further by incorporating amusing melodies and sounds that stimulate children more than other educational tools, such as basal readers (6). Indeed, our device fulfills all of the project's goals. It is portable, washable, electronic, durable, and provides tactile and audio feedback as well as volume control. To conclude, we developed and assembled an electronic device that encourages Stephanie and other children with visual impairments to learn the Braille alphabet by making the process fun and engaging.

REFERENCES

1. National Federation of the Blind. (2011). *Braille Readers are Leaders* [Online]. Available: http://www.nfb.org /nfb/Braille_coin.asp. Accessed: 02/07/2012.

2. National Eye Institute. (2009). *Facts About Retinopathy of Prematurity* [Online]. Available: http://www.nei.nih.gov /health/rop/rop.asp. Accessed: February 14, 2012.

3. Wellington Regional Medical Center Retinopathy. *A Common Complication of Premature Birth* [Online]. Available: www.wellingtonregional.com. Accessed February 14, 2012.

4. *Learning Braille* [Online] Available: http://www.nationalbrailleweek.org/page/learning-braille. Accessed February 6 2012.

5. RobotShop. (2012). *uMP3-MP3 Playback Module [Online].* Available: http://www.robotshop.com/rogue-robotics-ump3-mp3-play-back-module-2.html. Accessed April 3, 2012.

6. Family Education. (2012). *Basal Readers* [Online]. Available: http://school.familyeducation.com/reading-and-language-arts/reading-instruction/38685.html. Accessed April 3, 2012.

ACKNOWLEDGEMENTS

- National Science Foundation grant #CBET 0966571
- Richard Goldberg, Faculty Advisor
- Diane Brauner, Project Advisor
- Kevin Caves, Faculty Advisor
- Phillip Thompson, Phillips Hall Machine Shop Manager

FIRST AUTHOR
Seong-Hee Yoon
6123-G4 Farrington Road
Chapel Hill, NC 27517
seonghee@live.unc.edu

About resna1238sdc
View all posts by resna1238sdc →

assistive technology, Braille, educational toys, visual impairments

← 2011 Participant Feedback

No comments yet.

Leave a Reply

Logged in as david. Log out?

Submit Comment