Solution for visually impaired people studying non-linear content

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Introduction

In the current era of information, software advances have made it possible for many once excluded minority groups to benefit from and connect with the evolving technologies available. Computers and other communication devices have become central fixtures in many people's lives for their ability to access and transfer necessary information quickly and effectively. Yet a large portion of Human-Computer Interaction (HCI) development is centered on visual interfaces, which hinders many visually impaired individuals' ability to gain from these improvements. In this project we propose a device concept that will bridge this gap and allow more of these users to access the same information available to the technological community as a whole.

Abstract

We designed a device which featured a tactile screen that can be used as scratch paper to both draw original diagrams and read imported ones, and is meant to be used concurrently with the student's other study devices to aid in the understanding of subjects which are very diagram-intensive. After conducting user testing with usability experts and consulting our end users on the functionality of our prototype, we received numerous suggestions on how to improve our device and add features while minimizing the complexity. We have redesigned the device with this feedback in mind, and have provided extensive details below. The next step in this development will be to once again conduct user testing, assimilate the results and upgrade the tactile screen into a superior model, and create a physical prototype to be tested.

Problem Space

We wish to design an interface to assist visually impaired students study non-linear content.

Research

We performed background research on the subject, which consisted of referring to various studies and reference material, as well as conducting short-answer questionnaires, semi-structured interviews and observational studies on a visually impaired university instructor, student and a sighted accessibility advisor. Based on our results, we found significant gaps in both transportation and the study of spatial or graphical content, which is often found in STEM subject (Science, Technology, Engineering, Math). Being students ourselves, and having a wider access to relevant resources, we decided to focus on the latter problem.

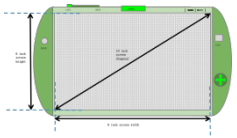
User Needs

Simple, easy-to-use interface to aid and promote the learning (i.e. reading and writing) of non-linear subjects such as Mathematics and Science in visually impaired students while maintaining low cost (i.e. lower than competitors' costs).

Design Requirements

Based on the user needs established during the background research, we decided to implement an interface that could act as scratch paper for visually impaired users, allowing them to both read and draw diagrams and symbols that current technology is not adept at handling. Our interface would ideally be portable, able to interact with users' other study devices (computers and software), able to handle spatial content, be minimalist and simple to use, and be cheaper than the currently available solutions.

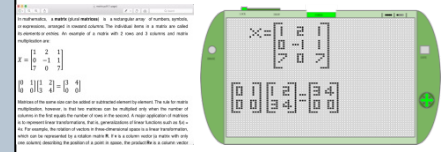
Initial Prototype



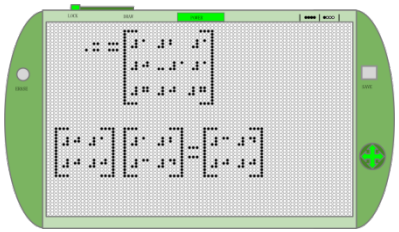
NOTE 1: All writing on device (button labels) will be implemented in Braille on physical prototype

NOTE 2: Raised dots are indicated in this poster as black, while lowered ones are white. This is just for our (sighted) usability; in real life they would not change color, they would simply be raised or lowered.

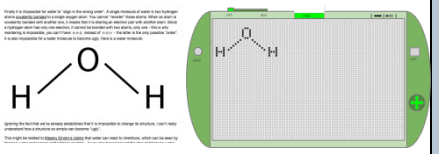
- **POWER** – depresses to indicate on
- **TACTILE SCREEN** – responds to user's touch
- **WRITE MODE** – allows user to draw/write on screen by pressing down and dragging
- **READ MODE** – allows user to read information on screen (either written by them or imported from computer)
- **ERASE** – allows user to erase portions or refresh whole screen
- **BATTERY LEVEL** – indicates battery life through raised dots
- **SAVE** – allows user to export information on screen to saved file on computer
- **ARROWS** – allows user to zoom in/out on the screen, and move content around



To import from laptop screen, set to read mode and select information to input on laptop. Note: device screen must be blank, otherwise user will be prompted on computer to confirm screen refresh. this is to make sure user has a chance to save important data from previous screen.



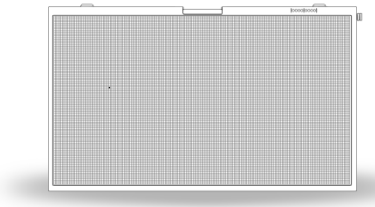
This device also works for braille. if the user prefers reading braille numbers to the numbers shown below, they can use their computers to translate the numbers in this image to braille, and then use the same procedure as before to re-import the image to this device.



Device Evaluation

The device concept was met with great enthusiasm from members of our blind target group. However, they were unable to test our digital prototype, and requested notification when a functional physical prototype was available. Sighted expert reviewers of the device prototype performed usability testing and made suggestions for improvement to the device prototype, which were incorporated into this final proposal. Suggestions included incorporating audible feedback of the device status, wireless PC connection using a dedicated transceiver and an asymmetric physical interface.

New Design



Based on device evaluation, we've re-designed our prototype to feature individual button shapes and a stand instead of handholds (thus freeing the user's hands and providing asymmetry). We've also re-design the tactile screen so that a stylus could be used to write rather than the user's fingers, thus allowing for thinner lines and more precision, and would allow the user to use both hands to immediately feel what they're writing. Since hands would not affect the screen at all, we do not need Read/Write modes anymore.

Future Work

Future steps in the project include further prototype testing by end-users and experts in order to gain feedback on the new design and refine the device further. Once done, we would like to create a physical prototype to allow actual interface testing by visually impaired individuals.

Contact information

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