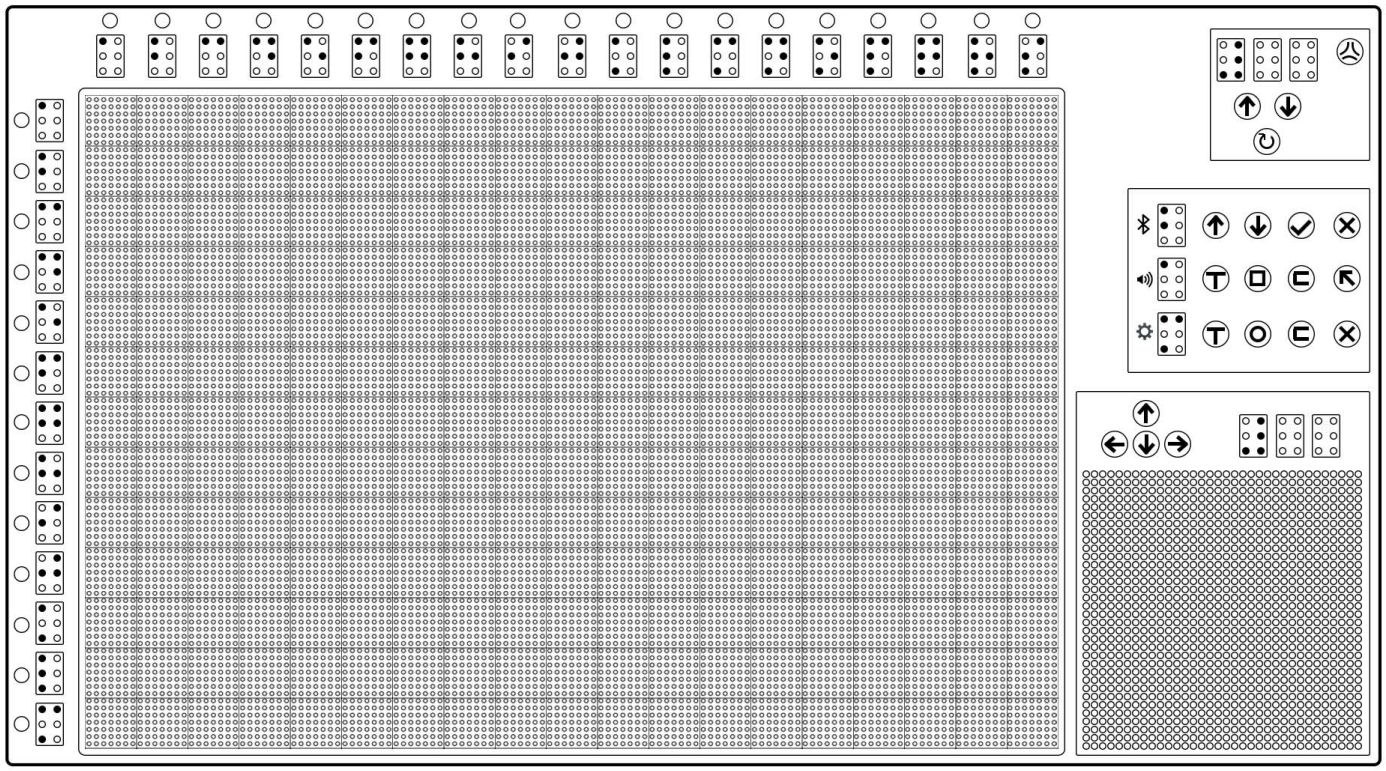
Plug N' Braille is an external hardware device which can be connected (either via usb wire or Bluetooth) to any device with a screen. The device will then take snap shots of the connected digital screen and process it. The end result will be a translated braille representation of the computer screen to the Plug N' Braille pad.

The Plug N' Braille differentiates its self from other available screen readers by being a more general use tool. It functions independently from operating systems or other programs. This allows blind users to connect the Plug N' Braille to any computer. Anything that can be done or seen on the screen will be translated into the braille pad.

Show image demonstrating pixels from screen not being directly translated into braille

The screen readers currently available in the market embed themselves into the programs being used and are navigated via macro commands. This is limited to which software is supported for the screen reader tools. In addition, standard screen readers only allow the translation of text detected directly from the software in use to the braille device. Extra information aside from text would not be conveyed to the user.

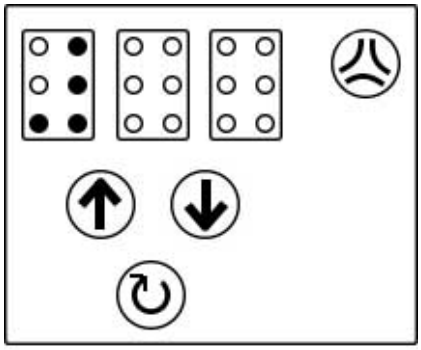
Show the full device design



Our tool is an external device that will allow use of the computer with standard equipment (mouse, keyboard, etc.). Desktop applications/use will be dynamically updated in real time to the user via the braille pad by translating screen captures from the device. This image is just representation of the overall design; it is not a representation of the final product. Certain panel positioning and sizes may be subject to change. Some features may also be added in or removed upon further implementation and testing. It should be noted that there will be a slight learning curve for using and understanding information for this device. As such a braille user manual or video could be created to help train the user with this device.

The braille pad device has two modes of updating information for the user; automatic refresh, and manual refresh. All information regarding snapshots pertains to the following snapshots panel.

Show Snapshots Panel



If automatic mode is selected, the device will take snapshots of the screen on certain intervals of time and translate it to the braille pad.

Highlight the automatic snapshot mode button

The automatic mode can be toggled on with this button at the bottom left portion of the panel. If the pin is pressed down, the device is toggled to automatic mode, otherwise the device is by default on manual snapshot mode.

Highlight the increment/decrement buttons

The user may increase or decrease the refresh rate when on automatic mode to suit their needs. The refresh rate ranges from 1 – 20 seconds. These buttons are located directly above the automatic toggle button.

Highlight the refresh value indicator

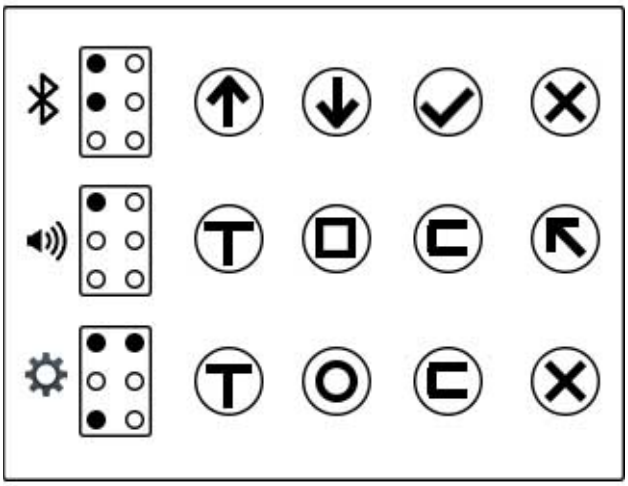
A braille indicator is located on the top left of the panel so the user can know how often the pad automatically refreshes information from the screen.

Highlight the manual snapshot button

The user may also switch the device to manual snapshot mode, so they can control when to take a snapshot of the device. This button is located at the top right of the panel.

Both of these modes will take another snapshot of the screen, and then store two copies of it; one in grey scale (for text and shape recognition), and the other in color (for pixel translation). The user may switch between modes at any time depending on what kind of information they need.

Show the device options panel



Below the snapshot options panel is the device general options panel. Here the user can control how information is conveyed between the computer, braille pad, and the user. There are three separate aspects of controls. Each functionality control has its own row of toggle-able buttons. There are braille letters for each category located at the far left to help indicate which modes there are for that row. The letters (from top row to bottom) *are **B** for "Bluetooth" settings, **A** for "Audio" settings, and **M** for "Special Modes" selection*.

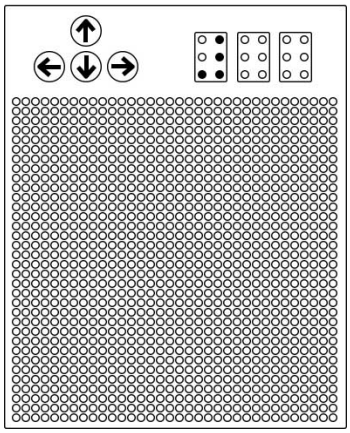
***Highlight first row of options "Bluetooth" ***

Starting with the first category of options on the top row of the panel; the "Bluetooth connector" allows the user to connect their braille pad device to any other device that has Bluetooth.

Highlight cycle buttons

By default, the device does not search for compatible Bluetooth devices. When the "next" cycle button is pushed for the first time, the Bluetooth discovery is enable on. From that point on, when the user pushes the cycle buttons, the device will indicate which Bluetooth device is currently selected (but not connected to).

Show the details panel



This will be done both by voice transmission as well as braille text. The braille text will be written below in the "details" panel.

Highlight the connect button

When the user has their desired Bluetooth device selected, they can hit the "connect" button to connect the braille pad to the other device.

Highlight the disconnect button

When the user is finished using the device, they may either power off the braille pad, or manually disconnect from the Bluetooth connection by pressing the "disconnect" button.

***Highlight the second row of options "Audio" ***

The second row of options is designed to act as a helper for contextual awareness. These options give audio queues for various aspects of the device.

Highlight the "Text to Speech" button

The first button detects any text in the currently selected grid on the braille screen and transmits it to the user via text to speech audio.

Highlight the "Indicate Selected Grid" button

The second button verbally communicates which grid is currently selected on the braille screen. If the device is currently in color mode, then the audio will also report which pin within the grid is also selected.

Highlight "color indicator" button

The third button can only be pressed if the device is in "color" mode. It is used to verbally communicate what the color of the currently selected pin within the currently selected grid is.

Highlight "cursor indicator" button

The fourth and final button verbally communicates which exact pin in which grid the mouse cursor is located.

***Highlight final row of options "device modes" ***

The final row of options are various toggles to switch how the device behaves. It will change how the braille pad translates and conveys information from the computer screen.

Highlight the "text mode" button

The first button switches the device to text mode. In this mode, the snapshot used will be in greyscale. This is for the purpose of being able to detect text on the screen and convert it to its equivalent braille representation on the "details panel".

Temporarily pop up the "details panel" *.

Any text detected within the currently selected grid on the main panel will be transferred to the details panel. If the entire text doesn't fit within the details braille panel section, the user may scroll to read further information with the arrow keys.

Highlight the "focus mode" button

The second button switches the details panel into focus mode, which allocates more pins per pixel and moves the finer detail in a grid over to the "details" panel. If there are higher definition shapes which were lost due to being down scaled by the limitation of pin size, the 7x7 grid from the main screen will have a 34x34 pin representation of that same grid portion in the details panel grid. This will allow the user to actually read much smaller icons and images on the computer that they wouldn't be able to otherwise.

Highlight the "color mode" button

The third button switches the device to color mode. In this mode overall shapes and figures will toggle the pins. However, when a grid is selected the "details" panel will report the actual color of the currently selected pin in the currently selected grid. The text will be written underneath where the pins are located with standard braille representation. The user may cycle through the pins using the arrow buttons.

Highlight the "de-select" button

The final button deselects any currently selected grid. This button can only be pressed when there is a grid that is currently selected.

Show the main braille screen representation panel

Now finally for the main aspect of this device, the screen representation panel. This screen will be where all of the pixel data from the screen will be processed and translated into the main braille panel. The size of the pins and the ratio of pixels to pins is not final or definitive at this point.

Highlight rows and columns of the grid braille letter indicators

The following braille letters indicate the rows and columns of the grids for the main screen. The pins beside them will push outward indicating that the grid is currently selected. At any point, with enough pressure the grids on the main screen can be pushed down and selected. Doing so will toggle the various extra information requests previously stated in the demonstration. The grids themselves can be directly pushed down to be selected, or their associated indicator pins can also be pressed downward to signal a grid selection.

There are different levels of elevation when a pin is raised to indicate different kinds of information. A pin that is not raised either indicates a white pixel or an empty space. A pin raised one notch indicates a standard shape detected. A pin raised two notches indicates it belongs to a group of text. Finally, a pin raised three notches indicates the location of the mouse cursor. When in text mode, only the pins which indicate the border or grouping of a shape are raised. For example, if a folder is opened on the desktop, the pins will only raise for the borders of that folder, any text or additional icons contained, and any white/empty space in the folder will not raise pins.

Submission Points:

Accessibility

The product allows users to gather more information as well as the context around the main applications of ordinary computer use. By having a better idea of positioning and layout made possible by the pixel representation screen; people can now use computers with more freedom and capabilities!

This opens up new possibilities of multi-tasking with multiple programs, macro-free navigation, and the ability to learn how to use new applications which don't require support from traditional screen reader tools.

Creativity/Innovation

Image recognition tools are the driving force of this product. The device uses artificial intelligence to detect shapes, colors, and text without needing any additional help or requests from the applications in use.

The shape recognition allows the layout and desktop of the computer to be fully converted into a braille representation. This allows for full unrestricted control and navigation of the computer using its standard equipment. Certain aspects for the desktop were not shared with the user with traditional screen reading tools. With the Plug N' Braille, things like desktop icons, regarding their shape, color, and positioning on the desktop can now be known!

The color recognition gives a general sense of the palette and color scheme of the screen, allowing the possibility of using creative tools like Photoshop to create art or other images from scratch!

Applicability / Value Added

All of these aspects addressed by the image recognition software will greatly enhance everyday life. Computers are a major aspect of modern society and control major aspects of our lives. Most careers require at least some user of a computer. Most tasks we carry out can also be done with the use of computers. These are daily activities we partake in, and being able to use these machines freely and with ease drastically changes our lives. We hope that the Plug N' Braille will offer new opportunities, for jobs, daily recreational use, and educational use!

Feasibility

Most of the features proposed with this idea are designed around currently existing tools that do the job we designed. Microsoft Azure offers very robust image and text recognition tools for the main screen translator

of this device. The main hurdle will be the hardware aspect. Our team is comprised of programmers with very little knowledge of hardware or mechanical engineering. However, after some research we have learned that the product can be designed with cheaper materials to reduce cost. Currently, the text recognition portion of te project has been tested and completed. However, we still need to learn the braille syntax and how to properly format the braille represented letters. Building some simple data structures to contain the information and flags for pins should be doable to simulate the hardware aspect of raising pins for the braille. We believe we are about 50% complete with the software.