Washington State School for the Blind

# Tactile Graphing Solutions

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## Client

Our client was the Washington State School for the Blind. Located in Vancouver, Washington, WSSB offers specialized quality education services for to the visually impaired and blind. Serving hundreds of children, their goal is to help their students find community and grow into independence.

## Problem Description

Sight is estimated to make up 80% of learning for sighted individuals, and this creates a large learning barrier for visually impared people. As such, our team was challenged to address this problem: How can graphical images best be simulated to visually impared people? There are currently many solutions to this problem, but they often involve costly components, or produce an excess of paper waste. Continuing a previous team's project, we were tasked with exploring a variety of directions to find an effective, reliable and more readily accessible solution.

## Final Design

Our team developed two solutions using vibro-haptics to display a graph to a user based on finger position. One uses a capacitive touch display to sense finger position, while the other replaces the touch display with an overhead camera and computer vision. Both employ small vibro-haptic motors mounted to the user's index and middle fingers to indicate the grayscale shade of an image at each finger's current position. We also explored using microfluidic actuation to display a graph using an array of inflatable bumps. This direction is still being explored and our current design is to demonstrate proof of concept.

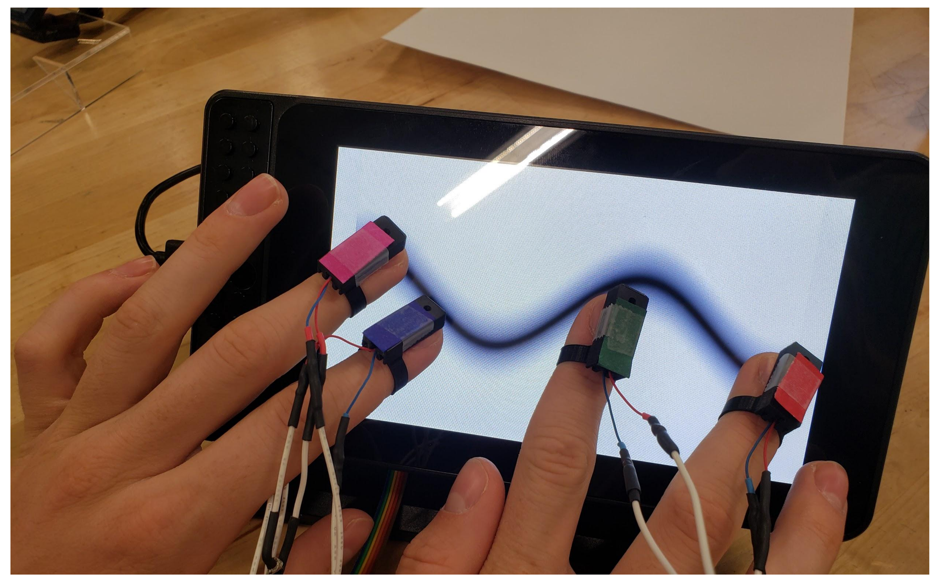

**Figure 1.** Vibro-haptic motors being used to provide tactile feedback based on information from touch screen

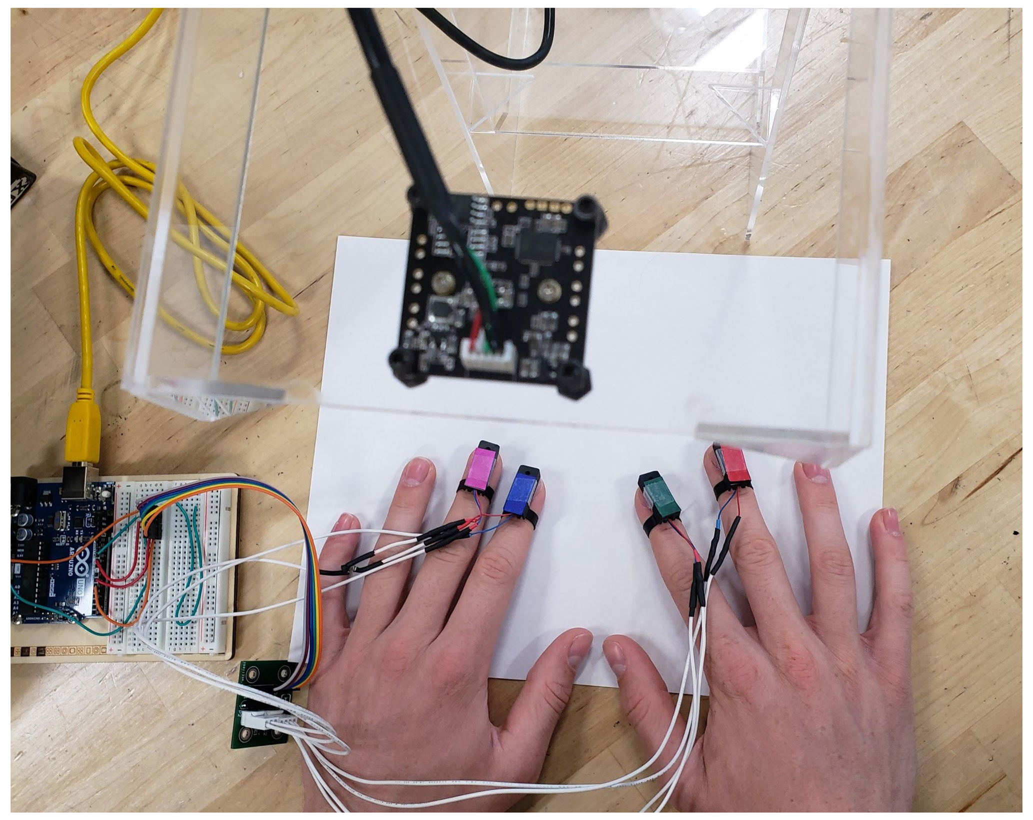

**Figure 3.** Using a webcam and computer vision software, we can give the same feedback on a larger, easier felt surface.

**Figure 5.** Current microfluidic solution created from a PDMS body bonded with a flexible film

**Figure 2.** Computer vision tracking software, based on the location of a specified color

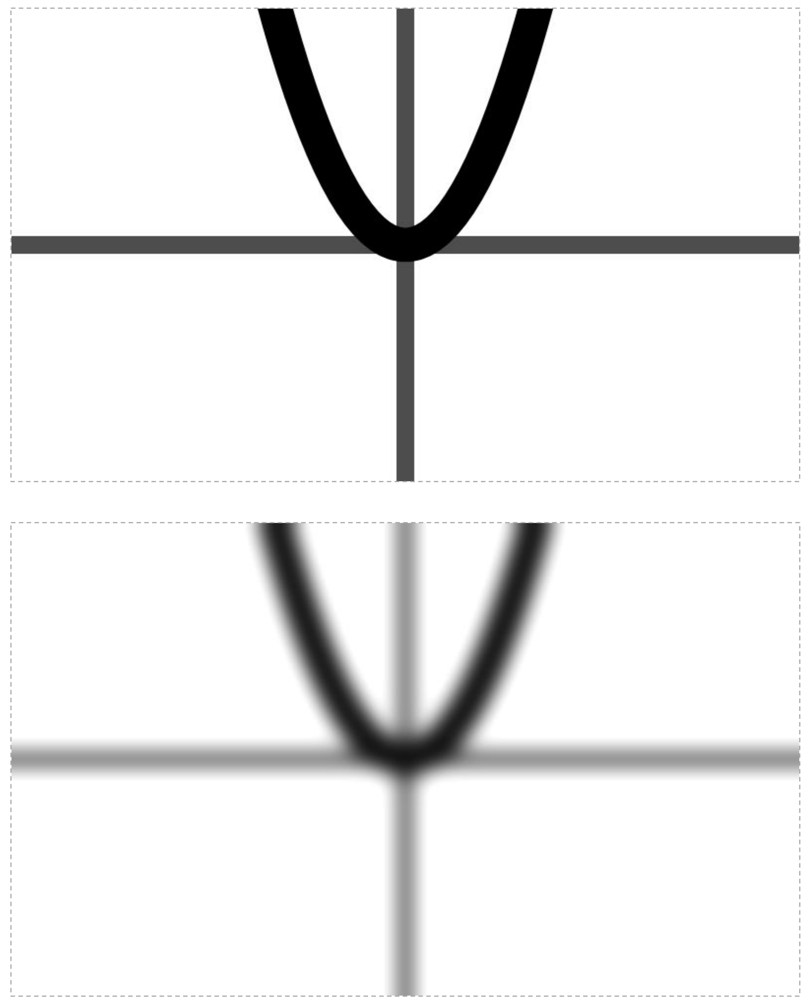

**Figure 4.** Slightly blurring the image makes for a smoother transition between grayscale values

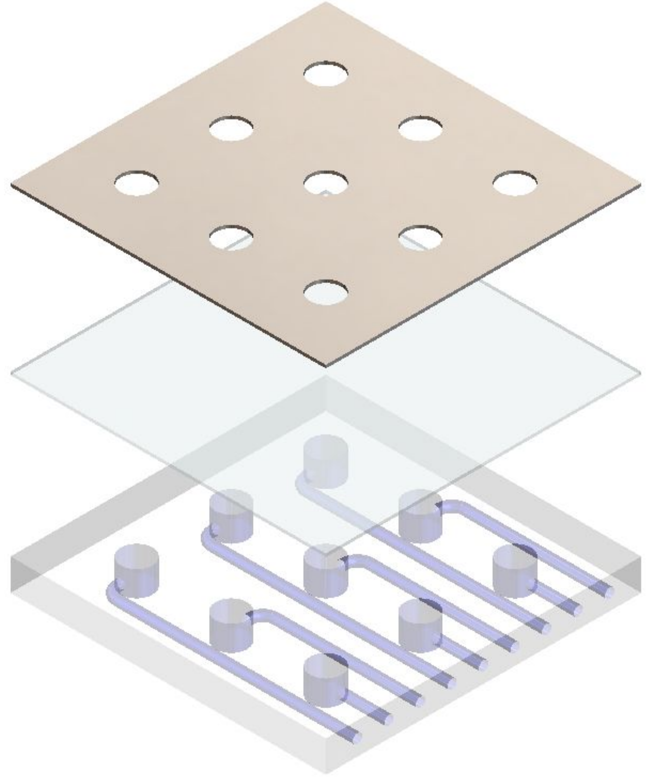

**Figure 6.** Microfluidic solution using a 3D-printed body, flexible film and rigid steel layer

## Project Summary

We began this project with the work from last year's team, which consisted of the touch screen and software for single finger tracking on the screen. We first looked into different ways to express visual information through tactile feedback, and pursued two main methods: vibro-haptics and microfluidics. We explored both of these solutions thoroughly, and developed a demonstration for vibro-haptic feedback using both capacitive touch and computer vision.

## Goals for the Future

Future goals that we think would be worth pursuing include using pattern recognition for the computer vision tracking and to explore laser welding as a bonding mechanism for the microfluidic chip. A future team should design and implement a system for pumping fluid to the microfluidic chip to control when the bubbles raise and lower. A long-term goal is to design a microfluidic refreshable-braille tablet.

## Acknowledgements

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## Team Members

**From Left to Right:** Ethan Reimer, Joshua Consenz, Nathaniel Hudson, Dillon Rising, and Michael Ching