Communicating Directions through Haptic Vibrations

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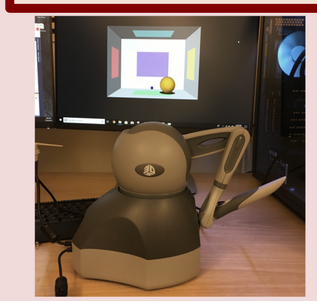
Introduction to Haptics

Dr. Culbertson's lab is researching how to improve haptic devices and new ways to apply them. Haptic devices relay computer generated touch sensations to the user and they can take many forms such as a glove, a sleeve, a vest, or a pen. There are many ways to generate the touch sensations. Some devices use voice coils or buzzers. Other devices use actuators or hydraulics. The output of a haptic device is also varied and depends on the purpose of the device. A device can produce sensations from vibrations to mimic the sensation of having your arm stroked. Haptics are becoming more prevalent in today's society. For example, waterproof cell phones contain haptics to mimic the sensation of pushing a button while still maintaining a sealed surface. Haptics have potential to improve medical training simulations and video game experiences.

Research in the HaRVI Lab

Several individual research projects relating to haptics are being completed within Dr. Culbertson's HARVI Lab. Naghmeh Zamani, my SHINE mentor, is working with a haptic device called Touch Haptic which resembles a stylus and a Kinova robot which resembles an arm. Zamani hopes to use the Touch Haptic device as a remote control for the robotic arm since the haptic device can be moved intuitively in three dimensions. It can also provide real time feedback to the user which improves accuracy. An application of this project could be to place the haptic device on a wheelchair so it can be used to manipulate a robotic arm in the far distance which will assist people with a disability to complete a task. Other projects in the lab include using haptics to assist the blind with computer programming and creating sleeves that generate a stroking sensation. All of the research in the HaRVI Lab is conducted with the goal of improving people's lives.



Touch Haptic Device
PC: Rachel Lobl

Kinova Robot
PC: Rachel Lobl

What I Learned

Throughout my time in the HaRVI Lab I learned:

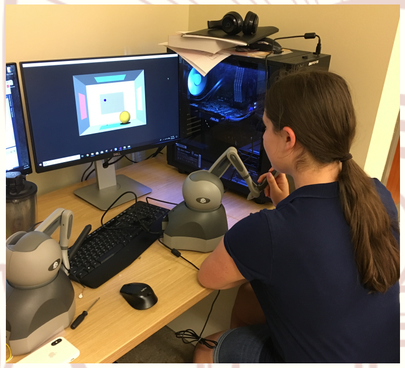
- How to use the 3D modeling software, Onshape
- How to solder electronics
- How a resin 3D printer operates

I have also learned:

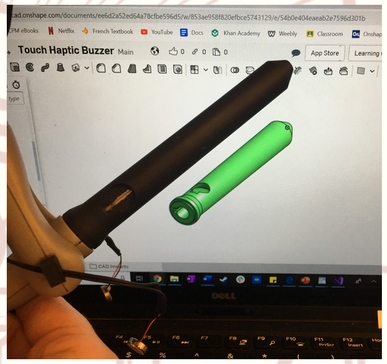
- About the research process at a university
- What it is like on the USC campus
- That research takes flexibility and a lot of trial and error

Skills I Got to Review and Use:

- Arduino
- C++ programming language
- Breadboards and circuits



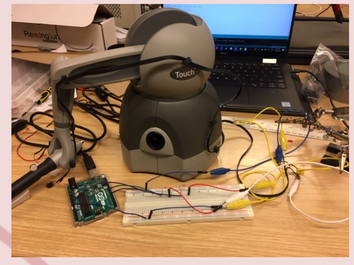
Rachel Lobl uses Touch Haptic to interact with virtual simulation. P.C. Rachel Lobl



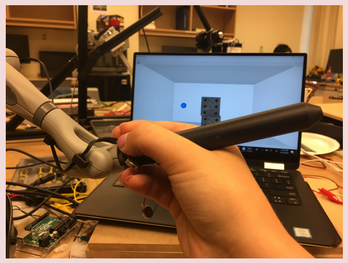
A 3D model of a stylus in Onshape and printed using a resin 3D printer.
P.C. Rachel Lobl

My Contribution

This summer, I modified a Touch Haptic device by creating a new handle for my mentor, Naghmeh Zamani. This will be used to teleoperate a Kinova robot. I added buzzers to the handle to generate vibration feedback which will guide the user to a particular location. Zamani is creating a computer algorithm to suggest the correct direction to the user by haptic feedback based on their movements. The buzzers in the handle will then generate vibrations to communicate to the user which direction to move the pen. For example, the right buzzer will vibrate to prompt the user to move the pen right. Eventually, the buzzers on the handle I have worked on will be synced with my mentor's computer algorithm.



Touch Haptic with buzzers and Arduino. P.C. Rachel Lobl



New handle is used in virtual simulation. P.C. Rachel Lobl

Obstacles

When controlling the Kinova robot, users had difficulty applying the proper force to the object and positioning the arm correctly to pick up the object. By using the Touch Haptic, the user can receive feedback on the force applied to the object. By providing force or vibration feedback to guide the user to the proper position, the task can be accomplished precisely. The next step in the project is to create vibrations based on the haptic pen's location.

Advice for Future SHINE Students

Conducting research is very different from taking classes in high school. While working in a lab it is important to take initiative. Your mentors will not walk you through every single step of your task. However, if you have a question don't be afraid to ask. Your mentors are there to guide you but not hold your hand through the SHINE program. A great resource when you do not know how to do something is the internet. It is always useful to have instruction manuals open for the equipment you are using. Above all, be flexible, curious, and have fun.

Acknowledgement

I would like to thank Dr. Heather Culbertson for welcoming me into her lab. I would like to thank my mentor, Naghmeh Zamani, for the many hours she spent mentoring me. Additionally, I would like to thank my lab mates Shihan Lu, Xin Zhu, Emiliia Dyrenkova, Alex Atcheson, Yang Chen, M'Kya Williams, Kivilcim Cumbul, and Dustin Goetz for sharing their research with me and for the fun teambuilding activities. Lastly, I would like to thank Dr. Katie Mills, Dr. Megan Harrold, and the rest of the SHINE team for their hard work in organizing the program and for giving me this amazing opportunity.