

LUCI Summer Field Session: Project Ptolemy

About LUCI:

LUCI® is a pre-launch startup re-imagining mobility for power wheelchair riders. Driven by impatience with a world where wheelchair users are asked to wait when it comes to innovative technology, we created LUCI - A company founded to build to the need, not to the code. We sought out riders, therapists, ATPs and experts. We listened, and we got to work.

The LUCI product is an aftermarket accessory for power wheelchairs that offers security, stability and connectivity. It uses a multitude of sensors, an embedded processor, and multiple forms of wireless connectivity to provide a platform for future development of assistive technology for our riders.

Project Description

Ptolemy was one of the earliest cartographers in recorded history, mapping large areas of the Roman Empire, as well as devised instructions for others on how to map the known world. The challenge of project Ptolemy is to help LUCI map the world of accessibility for wheelchair riders, on their terms. Wheelchair riders navigate the world in a unique and often frustrating way that is invisible to most people. This could involve finding an accessible parking spot, figuring out where the curb cuts or ramps are (often not next to the parking spot), finding an automatic entrance, etc.

When traveling with my nephew or niece, both power wheelchair users, we often end up circling buildings trying to figure out a safe and easy way in. It's time consuming and frustrating. We should be able to look up the best route before we get there or as we arrive using our phones... but today we can not.

The LUCI system uses three Intel RealSense stereo vision depth cameras for collision avoidance and drop-off detection. With your help we will extend the use of these cameras even further, adding accessibility mapping to the capabilities of the LUCI platform.

The goals of Project Ptolemy will be divided into the following phases:

1. Develop a process for recognizing wheelchair accessible ramps using black and white images and depth data streamed from Intel RealSense stereo vision cameras mounted on the LUCI platform. This will likely involve image processing, computer vision, and Machine Learning techniques to recognize features of usable ramps in these images. This may involve usage of common ML/AI libraries such as TensorFlow, PyTorch, or Scikit-learn.
2. Port the ramp recognition algorithms and model to run on a embedded arm Linux platform with limited processing capabilities and resources. This could involve (but is in no way limited to!) working with GPU programming, utilizing SIMD instruction sets, or other hardware acceleration on embedded platforms.
3. Port the ramp recognition into the LuciCore software stack and LUCI production hardware used by our riders.
4. Post the location of recognized ramps to Google Maps via the Google Maps API over WiFi. The specifics of this are not yet set, and may be up to you to find out the best approach to use this data. It could involve creating a custom LUCI layer for Google Maps! Architecture and approach will be determined when we get to this step.
5. Add recognition and geographical tagging of additional accessibility features as time permits such as accessible parking spots and automatic doors/door opener buttons.

Desired Skill Sets

Technical Skills

This project will involve:

- Computer Vision and Machine Learning for detection of objects in different types of images.
- General purpose computing on GPUs possibly using OpenCL, or through usage of higher level libraries such as OpenCV or TensorFlow.
- Linux applications development.
- Embedded applications development with heavy compute resource constraints.
- Integration with Google Maps APIs and Maps ecosystem.

These skills are by no means required, or even expected for applicants. However, an interest in learning these things would be greatly appreciated.

Engineer Skills

In addition to the technical aspects of the project, there are many skills that we at LUCI believe all good engineers should have. These are:

- A laser-like focus on the independence and freedom of the end user.

- An ability to communicate, collaborate, and problem solve with engineers and non-engineers on a team.
- A love and appetite for learning new things on a daily basis.

Preferred Team Size

3 - 4

Where You Will Be Working

Our offices are located near Olde Town Arvada just off of the I-70 frontage road. We have a small office area, as well as a warehouse with a testing facility and sensor testing range. Most of the work for this project will be completed on-site. Being on site will provide you access to the hardware for the project, an area to test and develop your solution, and access to a group of engineers who are willing to help and excited to see you succeed. Some off-site work may also be required for field testing of both real world usage of the detection and mapping functionality. At LUCI you'll have access to snacks, beverages, and interaction with a close-knit group of amazing engineers and developers.

Employment Opportunities

LUCI is always looking for great interns and full time employees who show a great tenacity to learn and share the values of LUCI. There is a possibility, but no guarantee, of internships and full time employment following field session.

Project IP Ownership

Students will be required to sign a contract assigning ownership of their work to LUCI. We plan on using what you produce in the real world and we need ownership of the rights to do that!