Individual Lab Report #10

Hillel Hochsztein

Wholesome Robotics (Team E)

Teammates: Aman Agarwal, Dung Han Lee, John MacDonald, Aaditya Saraiya

November, 2019

Individual Progress

In the past few weeks I have continued worked on the visualizer tool for the monitoring pipeline. A key part of our deliverables is a tool for the farmers to understand the data that we collect and generate. For that reason, I have been focusing on integrating the visualizer into a completed monitoring pipeline. In the past two weeks we successfully integrated the entire monitoring pipeline (bag reading, inferencing, and visualization) to run from a single command, effectively completing our MVP. I worked on the save functionalities that allow the individual python scripts to talk to each other. I also worked on the bash script that launches the individual python scripts in order (and handles file management). One minor caveat is that the exposure rejection script, which aaditya has developed, was supposed to be integrated as well, as a way to speed up computation by skipping images that will not inference well, however due to a versioning mistake, we were not able to display it during our progress review. That said, it is not a part of the MVP, rather a key improvement feature.

I also implemented the notepad feature for the visualizer. This meant introducing another tkinter feature and saving the content into a json, such that it can be recalled the next time the cluster is opened. While the text field was straightforward to implement (after the requisite documentation research) saving the text to a file was more problematic, since retrieving the text could not be done as part of the standard callback button. With a little research I found the agreed upon work around and implemented that.

I then collected feedback for the visualization gui from the farmers during one of our field visits. This led to reconfiguring portions of the cluster gui, such that it would appear more attractively on the computer screen. Also I confirmed which additional features they feel would be most helpful for us to focus on in the upcoming weeks. During the field visit I also collected a large amount of high quality footage for use on the website and promotional materials.

I then turned my attention to the wheel guards, a task which we had deprioritized and rescheduled for this week. I ordered PETG sheets from mcmaster, and used a crease cutter to cut the 2x4 ft sheets into a 2x1 panel and two 1x3 panels. I then took the 1x3 panels, measured out the dimensions and bent them using the machine shops' strip heater and[assorted rods and frames to mold the corners. Attaching the guards presented a serious design challenge as we are not allowed to drill into the base of the robot. To solve this problem I attached the guards using velcro, first testing the adhesive on the back and its ability to stick to PETG and anondized aluminum. Velcro solves a number of problems, because it makes the guards removeable, and it adds a degree of compliance in the case of a more serious collision.

Interestingly, the slanted ends of the guards were more difficult, as they can not lie flat on the side of the robot (they would block the ventilation). Instead the approach at an angle, which makes velcroing harder. To solve this I wraped the stiff velcro over the thin edge of the guard to connect with a flat mounted strip of soft velcro (see figure 3 – bottom left). Since the other velcro mounting points support most of the guards' weight, the little bit of contact only needs to prevent bending of the sheet, which is does well, while introducing the aforementioned mechanical compliance. The resulting wheel guards are mounted onto the robot and will be tested in the field over the coming weekend.
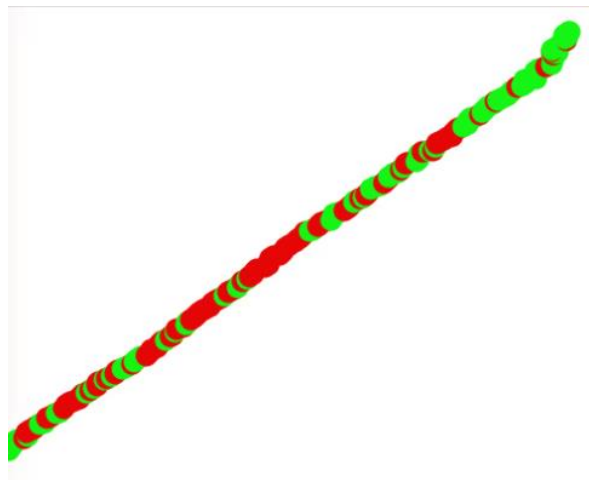

Figure 1 Clustered version of a Multiple row of plants. Green demonstrates healthy, Red unhealthy (this was run on through the entire monitoring pipeline).
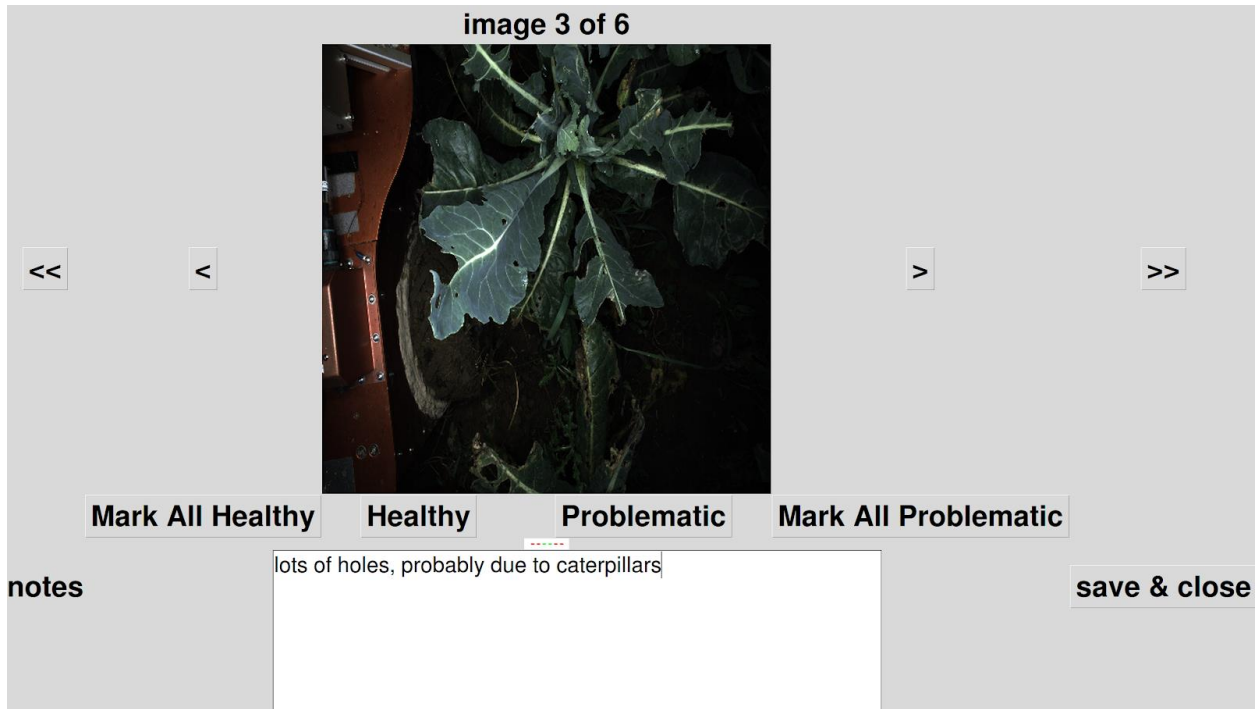
Figure 2 GUI includes readout for image number within the cluster, total cluster status bar, and navigation buttons that deactivate when unavailable (i.e. at the first or last image) and recently added notepad and 'save&close' button
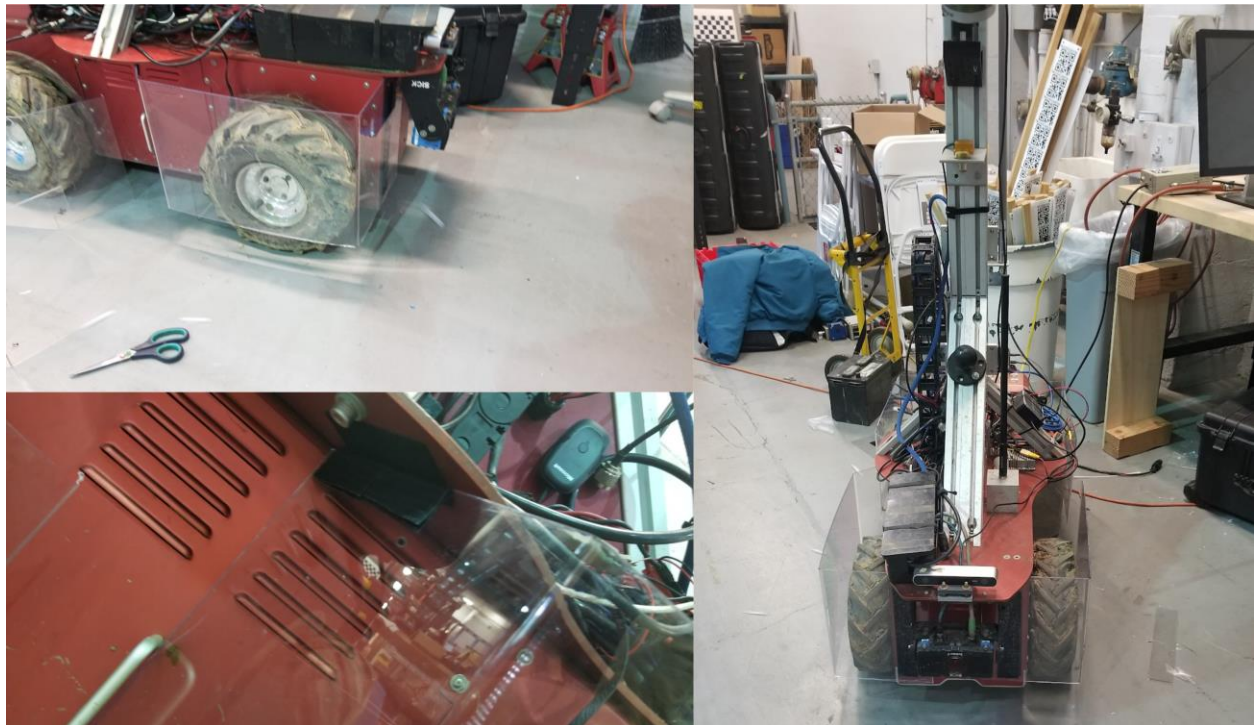

Figure 3 Plant guards installed on the robot

Team Progress

We have been working towards delivery of our MVPs both for visualization and for navigation. For visualization we have completed the base version of the pipeline. We plan to continue adding features and managing bugs in the next few weeks. For navigation we have worked on fusing different row detection and row navigation techniques (such as the lidar based detection, RTK guidance, and visual odometry) to fix issues we found with our row navigation.

Challenges

The biggest challenge I have faced has been time management. Due to my backlog from missing school in the past month, and the increase in assignments for other courses, I have been increasingly vigilant in making sure tasks are completed.

Integration has also posed a minor challenge, just because of stylistic and compatibility issues between my work and that of my teammates. As we reach issues we have endeavored to record them and come up with standards so that we can avoid similar issues in the future.

Teamwork

Aman has worked on the row navigation techniques, and specifically sensor fusion.

Aaditya has been working on visualizer integration and image exposure acceptance for the crop facing camera. He has also helped Aman with the navigation sensor fusion.

Dung Han has been working on evaluating the plant health model and fine tuning it, including comparing the current model with other architectures.

John has been working on the localization and navigation nodes. Specifically, he reworked the lidar based row detection.

Future Plans

Wholesome Robotics

In the coming weeks my plan is to finish the base features of the visualizer. This means changing the drawing and cluster GUIs, so that they represent results in both fungus and holes, as different values (whereas right now these are presented as a single "health" value. I will also be working on tightening up our pipeline integration, to improve reliability. Finally, I will be available to the rest of the team for help on their tasks, as our time diminishes.