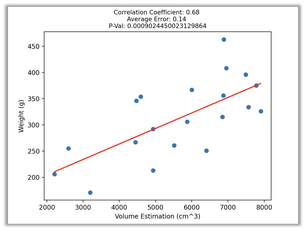
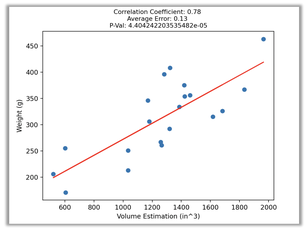
Experiment 1

Voxelization

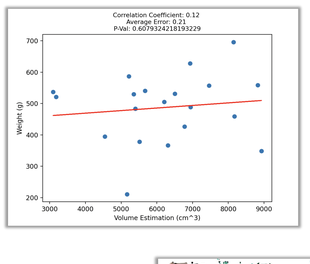


Convex Hull

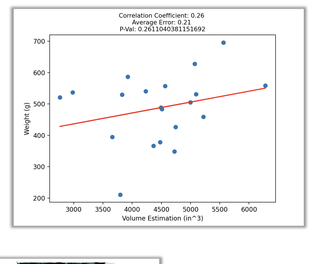


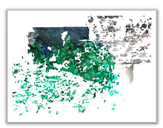
Experiment 2

Voxelization



Convex Hull





The Amiga

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We used **depth cameras** on a **modular robot** to **estimate** cilantro **harvest yields.**

Take a picture to **download** this **poster**

Crop Yield Estimation via Robotic Image Capture

*brought to you by team **Big Farma (CSE-302)***

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Clients:
SupHerb, UCM Experimental Smart Farm, Telit Cinterion

Mentors:
SupHerb – David Sieperda, Blaine Weber
UCM Experimental Smart Farm (UCM ESF) – Daniel Royer

Special thanks to the teams at UCM ESF and UCM Makerspace

The Problem

Our goal was to predict cilantro harvest weight using cameras mounted on the Farm-ng Amiga robot.

Our Solution

We used the cameras to capture point cloud images of the cilantro. We analyzed the point clouds in two ways, by 1) using voxels and 2) using the convex hull and density. Finding the coefficient that maps volume to weight through linear regression allows us to predict weight from volume.

We took captures using various camera setups on a diverse set of cilantro to varying success. From each experiment, we collected 20 20”x40” patches of cilantro.

Experiment 1 @ UC Merced Smart Farm

Cameras: 1 OAK D SR PoE Time of Flight (ToF) camera
Mount: Tripod
Correlation Strength: $p<0.001$
Compared to commercial conditions, the cilantro was sparser and had more weeds. The sparseness reduced occlusion, thus likely leading to a more accurate result. The ToF cameras have a better resolution than the cameras available to use in Experiment 2.

Experiment 2 @ SupHerb Farms

Cameras: 3 Oak D W PoE cameras
Mount: Amiga Robot
Correlation Strength: $p>0.05$
Cilantro had additional water weight from moist environmental conditions. Oak D W PoE cameras proved to have much lower resolution than ToF cameras.

Results/Discussion

While the first experiment yielded statistically significant results, the second experiment did not. Here are the two possible explanations, excluding a systemic error, in our believed order of decreasing likelihood:

1. The Oak D W PoE cameras are too low resolution to accurately estimate volume.
2. The correlation is too weak to detect in small samples.

Future Work

More data is needed to find correlation through noise, and more experiments with the ToF camera are needed for more quality data.
If successful, data can be collected and estimations can be made automatically on the Amiga’s computer, with the Amiga using its self-navigation through the field.