IOWA STATE UNIVERSITY
Computer Engineering

Honors Capstone Project
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Sugarcane Aphid Visual Detection on Sorghum

Motivation

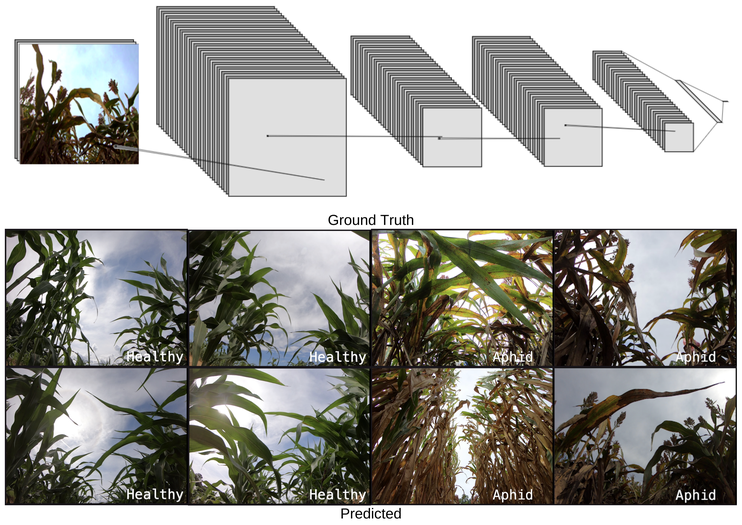
Sugarcane aphids present a severe economic problem to the sorghum industry. Aphid infestations sap nutrients and water from the plant hindering the development of the panicles. The current strategy for identifying aphid infestation is either walking through the field and counting how many aphids jumped on you, or by manually counting the number of aphids on sorghum leaf samples. Computer vision techniques and deep learning were examined as a tool to identify sugarcane aphid infestation in sorghum. This project leveraged the discoloration of sorghum leaves to identify plants that showed early symptoms of aphid infestation.

Data Preparation

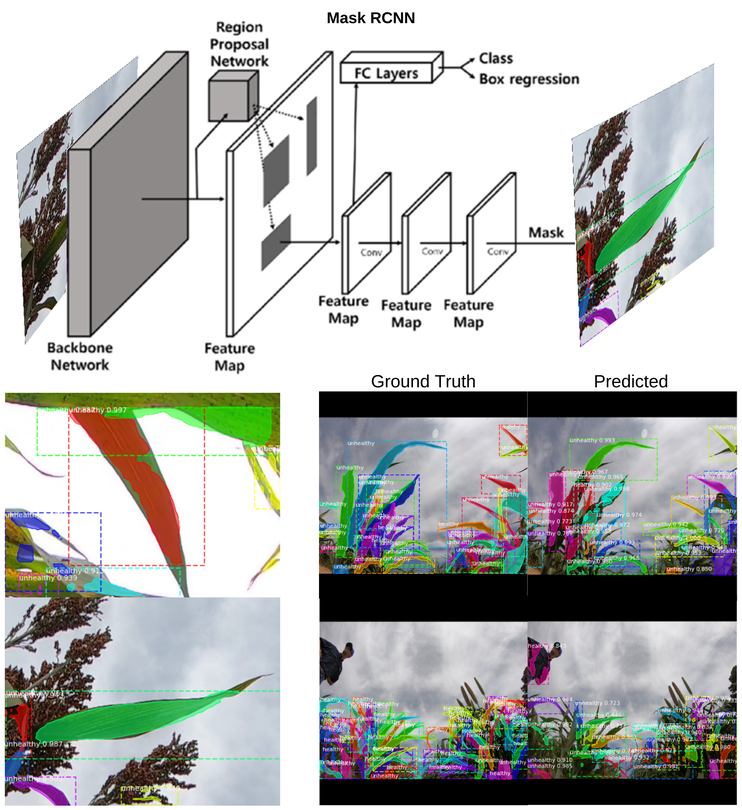
A remote-controlled robot filmed two Sorghum fields, one healthy and the other aphid-infested. The robot captured the view of sorghum crops from below. The video was taken on the same day for better consistency. A python script extracted frames from the video and removed the sky from the images. All frames were classified as containing aphids or not. A subset of the frames were manually annotated to train the leaf segmentation model.

Modeling Approach

Frame Classification Model



Leaf Segmentation Model



Results Summary

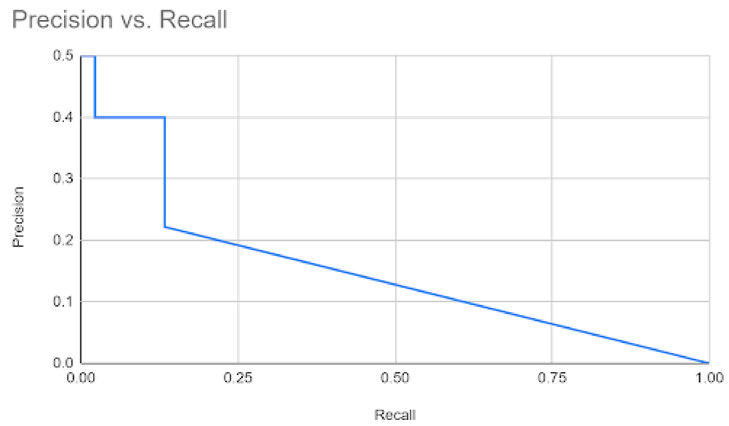
Frame Classification Model Results

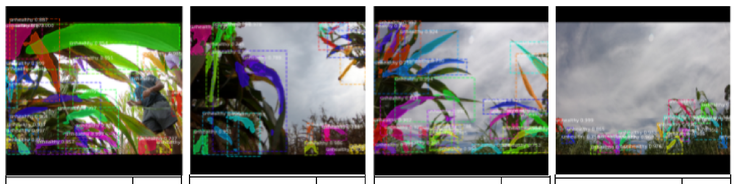
Table 1 - Detection Results of Frame Classification Using CNN

	Original Dataset	Background Removed Dataset
train time (s)	56	47
train accuracy (%)	71.60	73.26
test accuracy (%)	87.34	95.04

- **Background removal improves accuracy by 8%**
- **Loss function convergence occurred in < 1 minute**
- **Frame classification was 80% better than the leaf segmentation approach**

Leaf Segmentation Model Results





True Positives	6	True Positives	1	True Positives	4	True Positives	0
False Positives	16	False Positives	19	False Positives	23	False Positives	17
False Negatives	16	False Negatives	24	False Negatives	28	False Negatives	60

- **RPN loss functions did not converge in 167 epochs**
- **Leaf segmentation model is typically able to locate leaves but fails to classify them correctly**
- **Model may benefit from a different backbone with less layers**
- **Changing RPN anchors and scale may improve results**

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