Optimizing Plant Inoculation with Computer Vision and Adaptive Robotics

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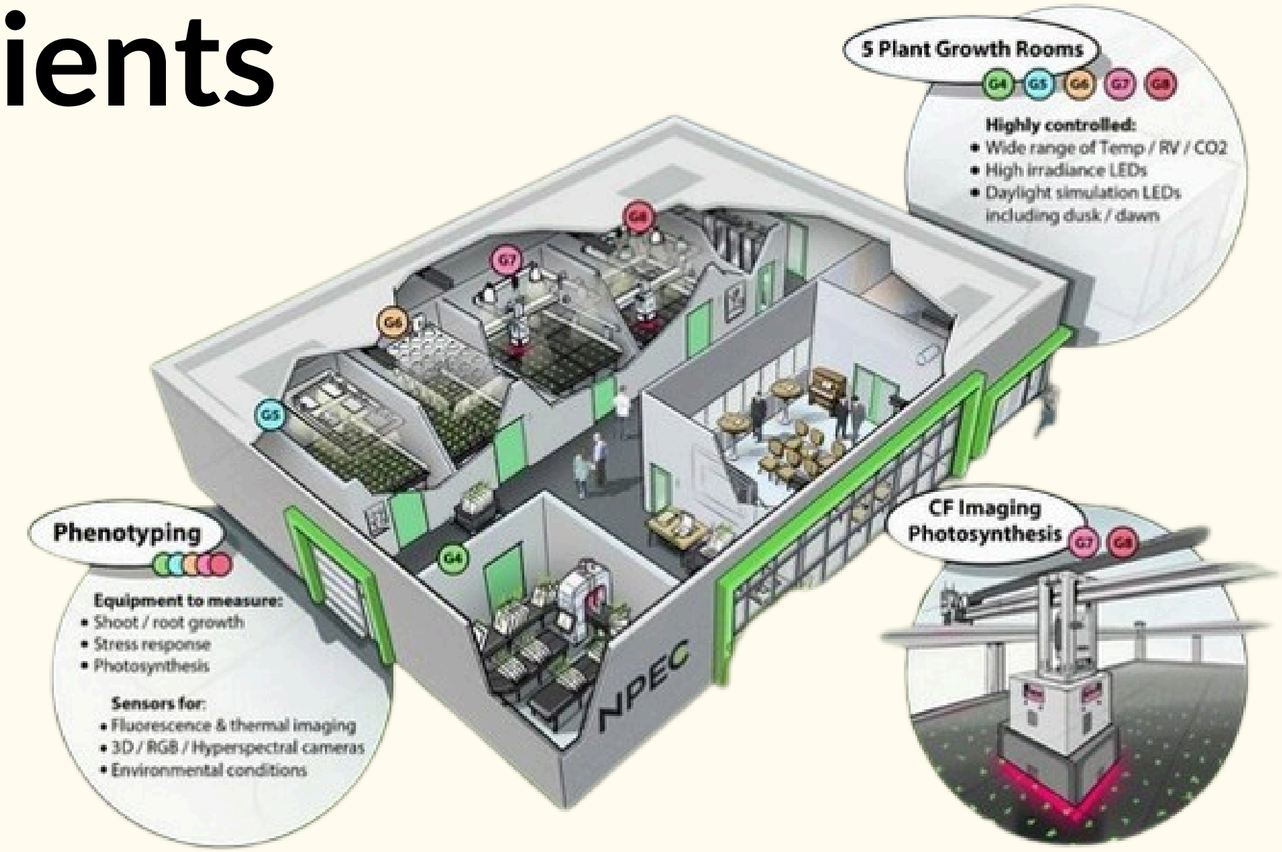
NPEC

1. Project Goal
2. Preproccessing
3. Training model -pipeline
4. Robotics training RL, PID
5. Pipeline CV with Robotics

PROJECT GOAL

1. Clients
2. Dataset

Clients



Plant phenotyping

Measuring plant traits precisely.

Plant-Environment Interaction Studies

Exploring growth under conditions.

2023 dataset

88 images

2024 dataset

450 images

TOTAL

Validation - 45 images, train - 315 images

PREPROCESSING

1. Cropping
2. Segmantation
3. Dataset Preparation

Task 2

Cropping and edge detection

Original image

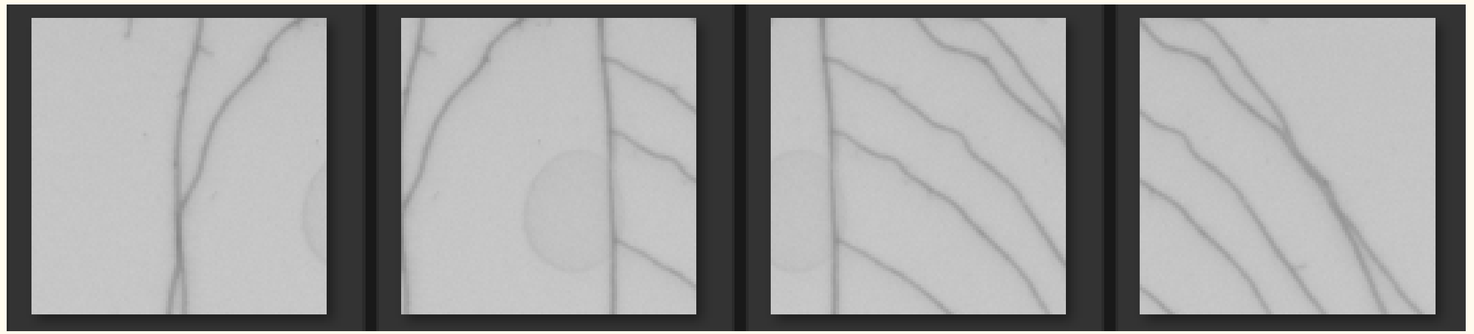
Cropped image

Task 3

Image Segmanatation

- Used traditional CV techniques (thresholding, morphology, connected components) to segment individual plants.
- Highlighted and visualized the top 5 plants with a bounding boxes and clored the with virdus map .

Task 4



```
# Patchify images and masks
image_patches = patchify(padded_image, (patch_size, patch_size, 3), step=128)
mask_patches = patchify(padded_mask, (patch_size, patch_size), step=128)
```

Extracting and patch

extracting 2023 and 2024
step size = 128
patch size = 256

Spliting

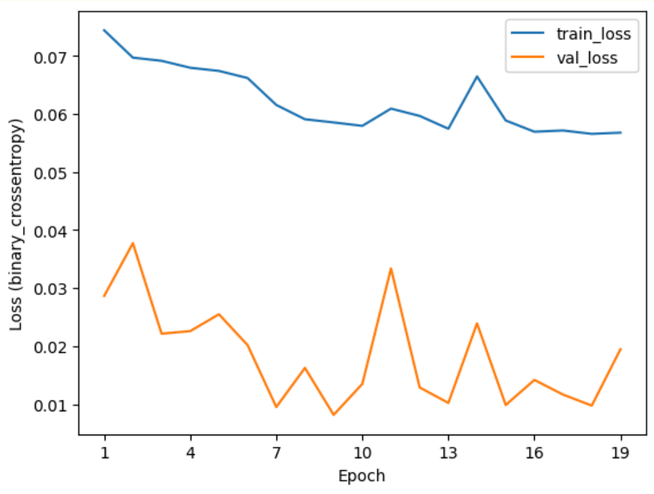
Train - 133623 pathes
Validation - 5445 patches

TRAINING MODEL -PIPELINE

1. Model training
2. Segmantation
3. Skeletonization
4. Kaggle submission

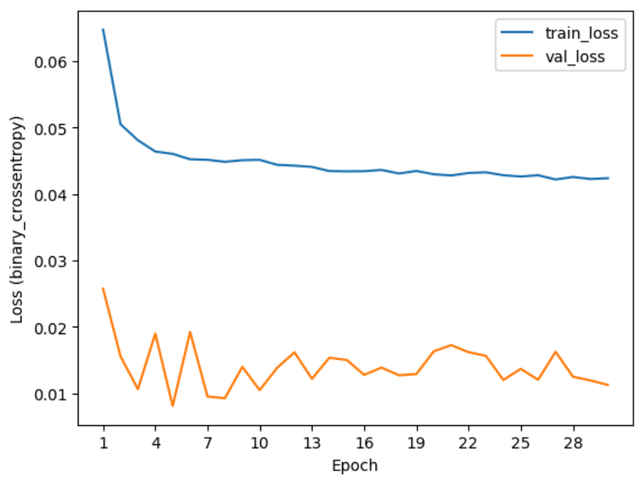
Task 5

Training models



Model 1

patch size = 256
Step size = 256
val_f1 = 0.8003
2024 dataset



Model 2

patch size = 256
Step size = 128
val_f1 = 0.8274
2024 and 2023 dataset

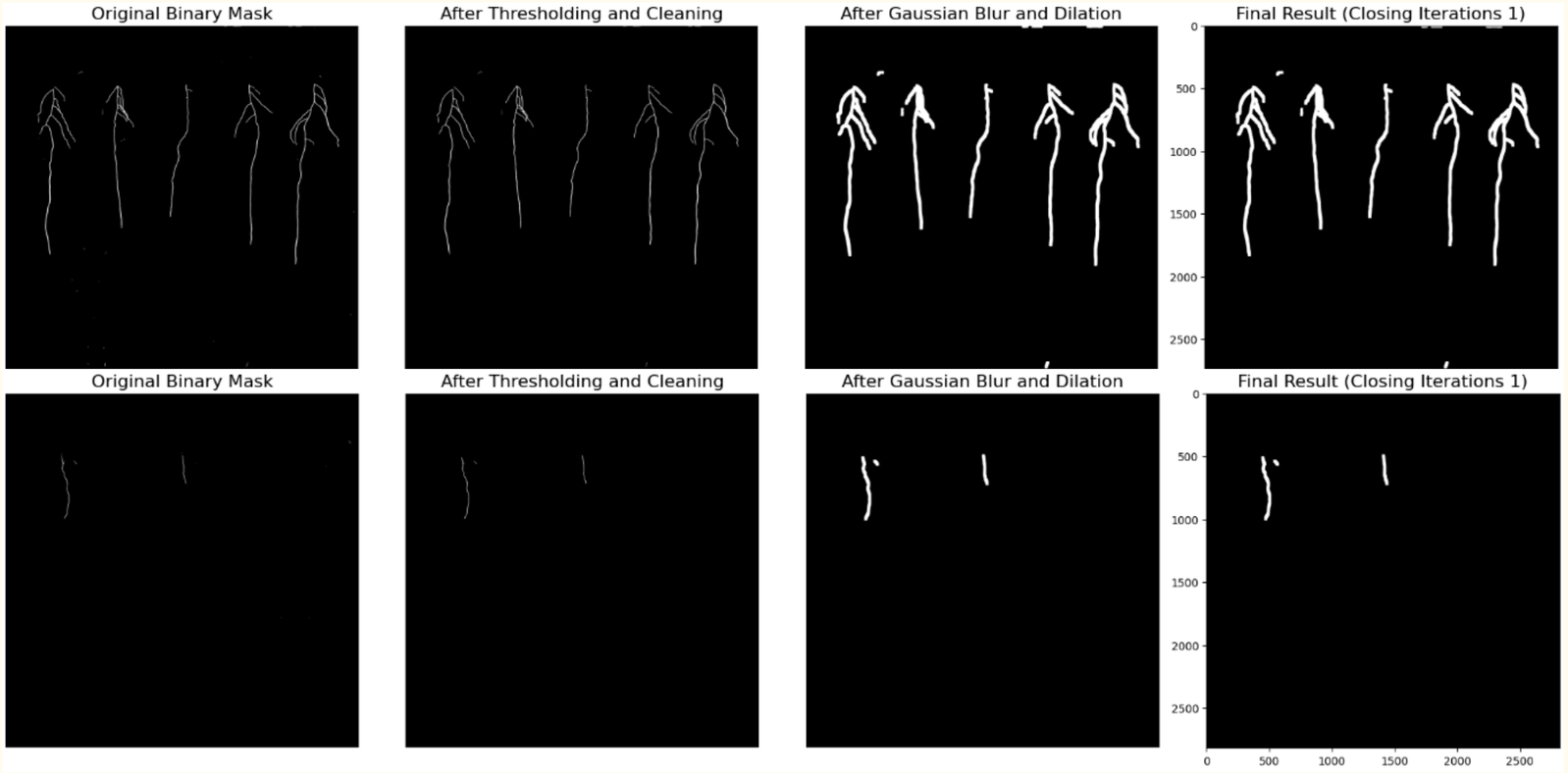
U-net model architecture

Model 3

Transfer learning
patch size = 256
step size = 128
val_f1 = 0.7234

Task 6

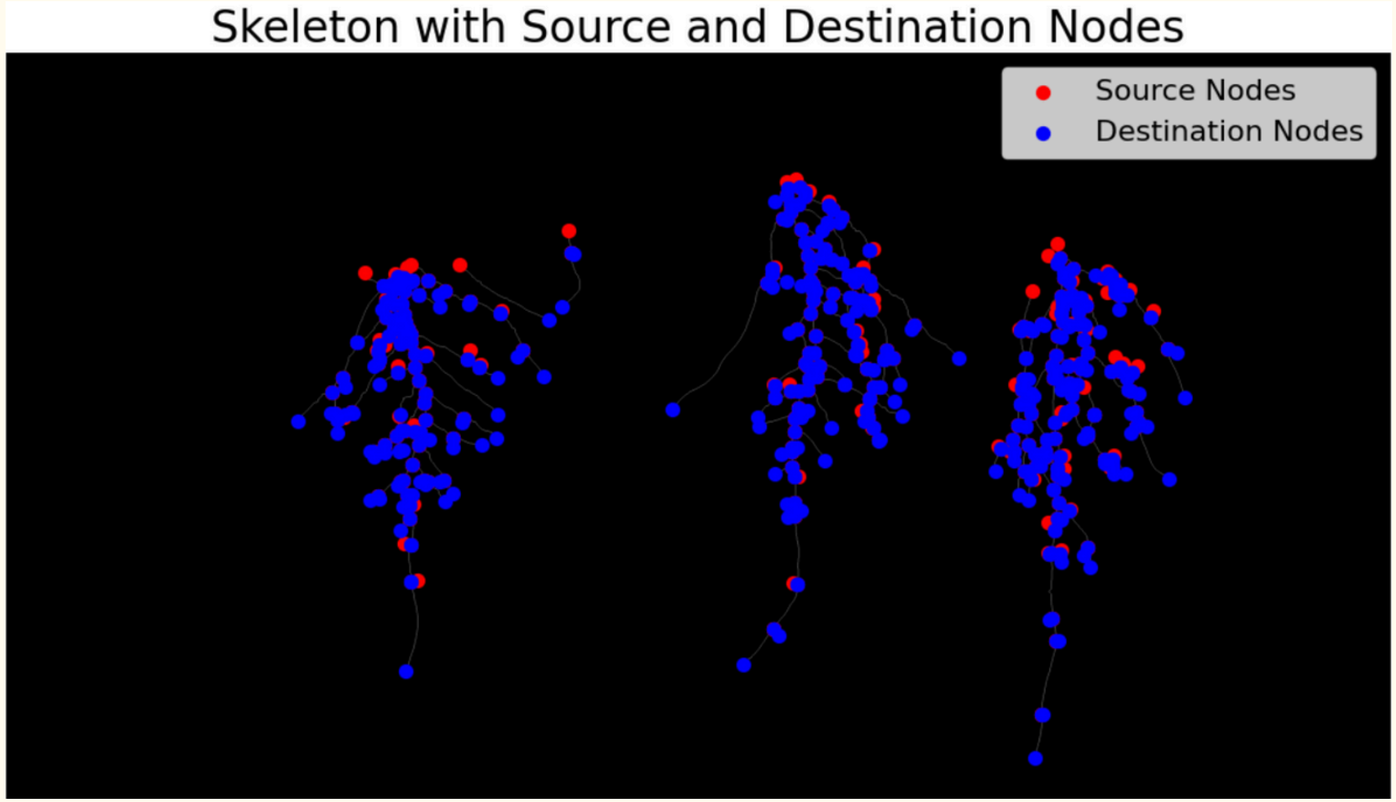
Segmentation



- Iteration 2: Closing 5, Min size 60
- Threshold 0.5
- Dilation 4 (6x6 kernel)
- Post-processing: Dilation + Erosion

Task 7

Skeletonization



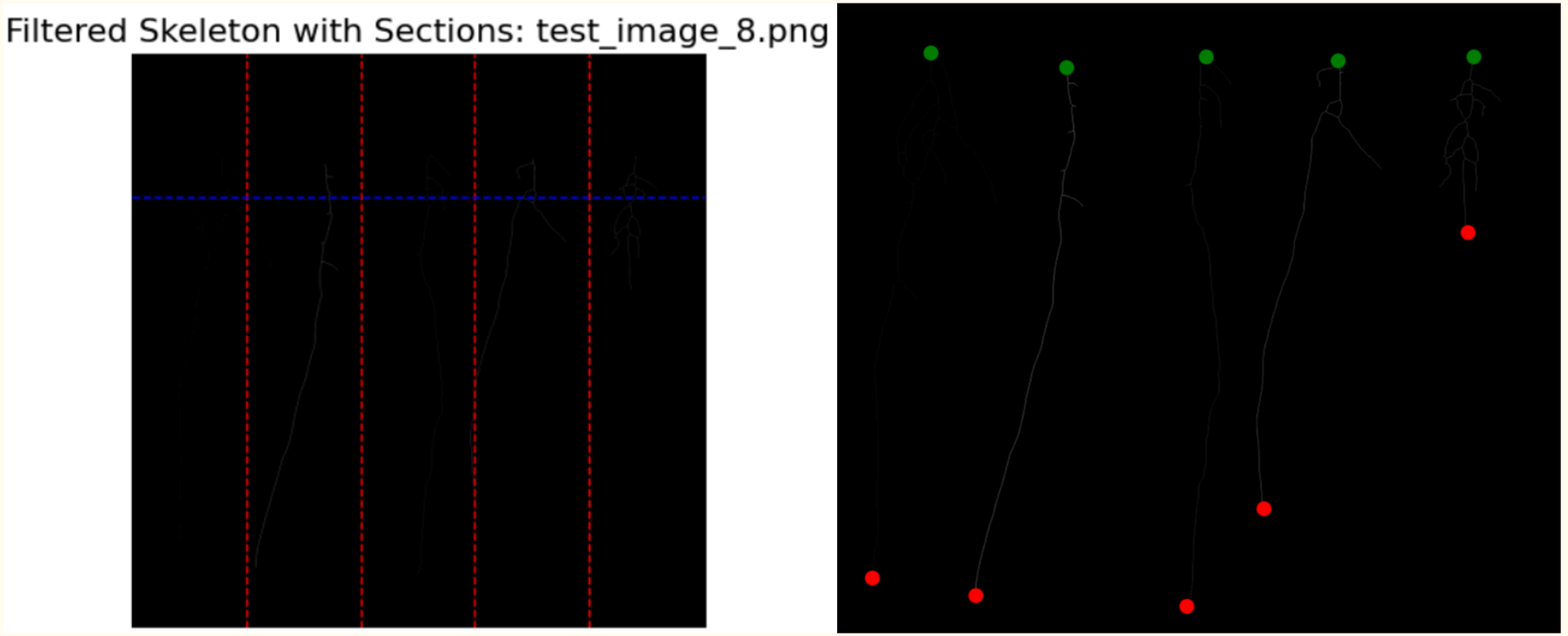
G = nx.from_pandas_edgelist(branch_data, 'node-id-src', 'node-id-dst', 'branch-distance')

Max_y = bottom node

Min_y = Top node

Task 8

Iterations explanation



Iterations

1. Default
2. Made a sector horizontally and vertically
3. Component removal x and y.
4. Adjustment 5th sector

Leaderboard

#	△	Team	Members	Score	Entries	Last	Solution
1	▲ 1	Ionut-Alberto Botoroga 230036		5.325	8	2d	
2	▲ 16	Jason van Hamond 232567		5.871	16	5d	
3	▲ 6	Louie Daans 232345		6.367	15	4d	
4	—	Thijn Bakker		6.807	15	4d	
5	▲ 2	Carlijn232166		7.033	16	5d	
6	▲ 13	Márk Molnár 232926		7.254	26	2d	
7	▼ 2	**Petar Paskalev**		7.456	17	3d	

✓	**submission_18_01_02.csv** Complete · 4d ago	**7.456**	**2.916**	☑
✓	**submission_18_01.csv** Complete · 4d ago	**10.574**	**2.916**	☑
✓	**submission_16_01 - Copy.csv** Complete · 5d ago	**15.228**	**3.269**	☐

Pipeline computer vision

Preprocess

Cropping, Patching

Training model

U-net model training

Segmentation

removing small object
opening and closing

Skeletonization

skeltonize taking top
y and bottom y

ROBOTICS RL, PID_CONTROLLER

1. RL
2. PID_Controller
3. Pipeline

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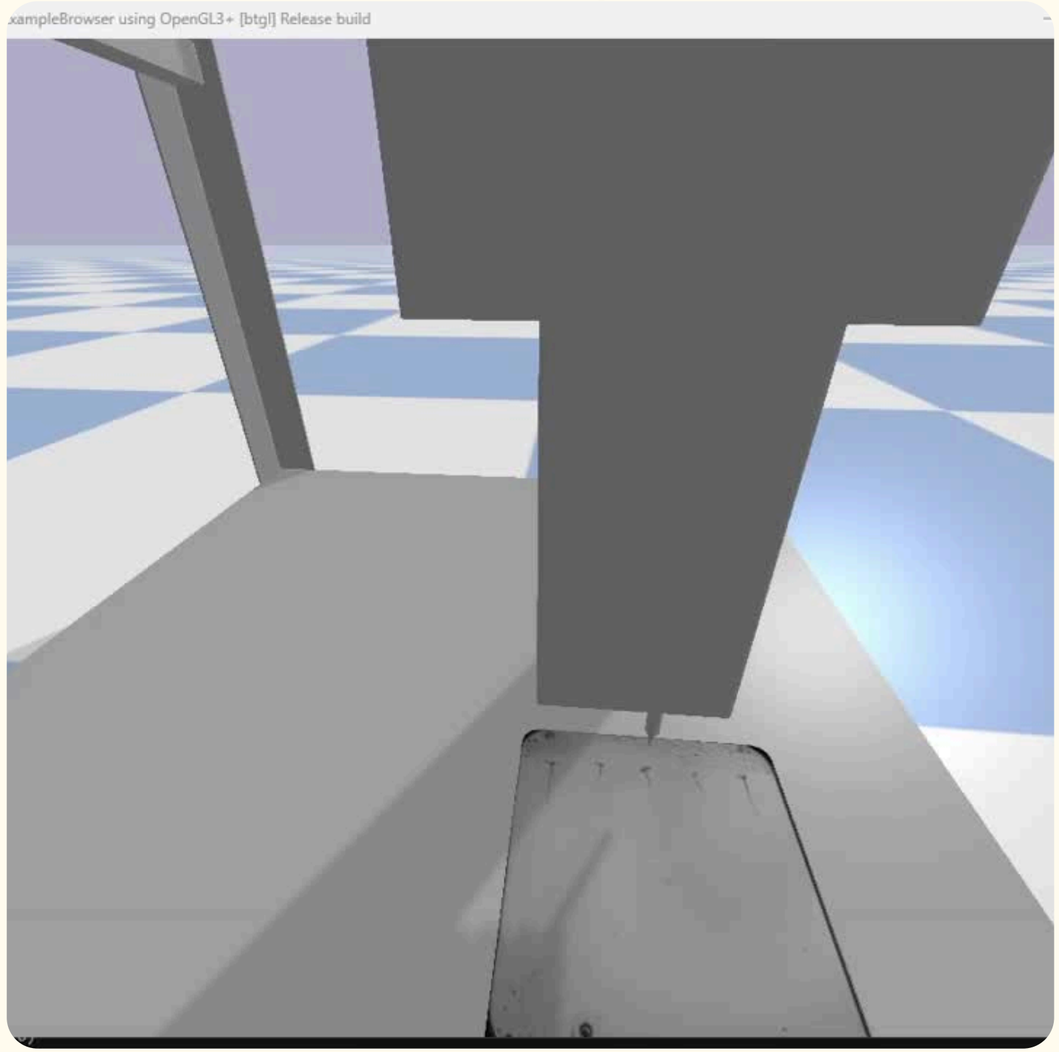
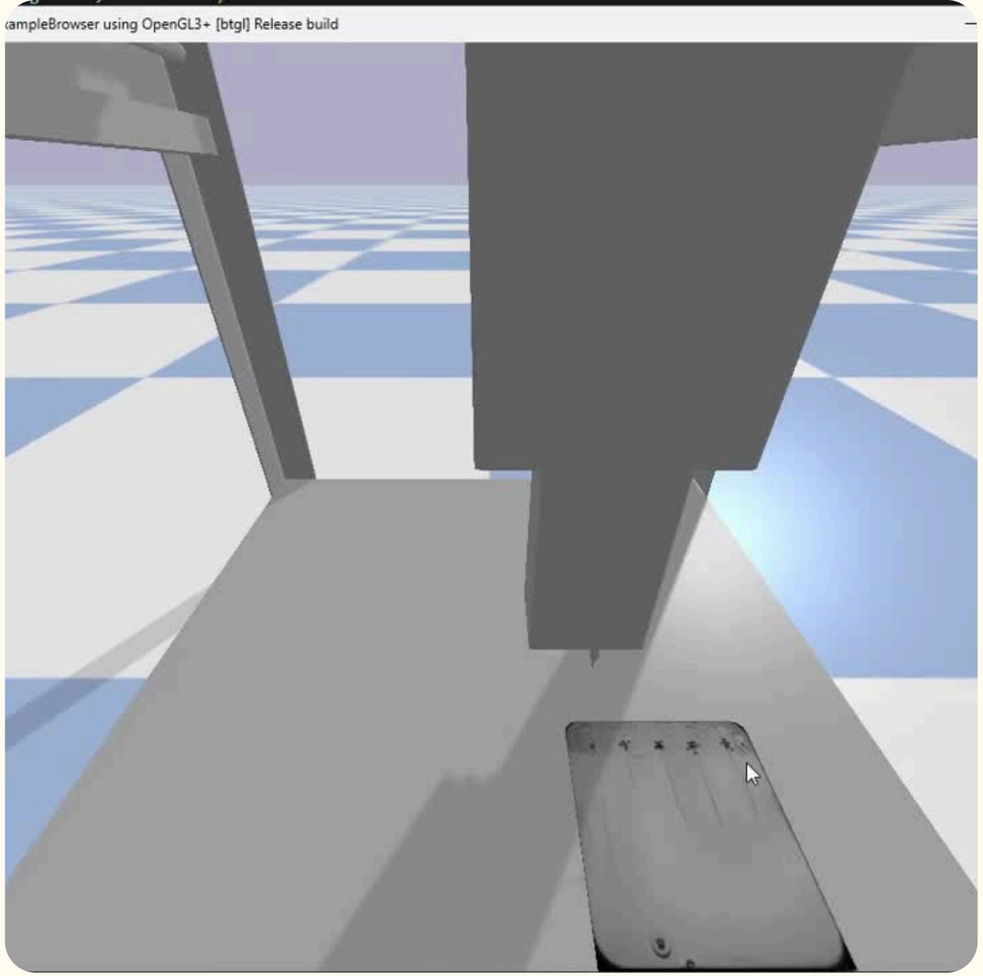
Reinforcment learning

need for improvment





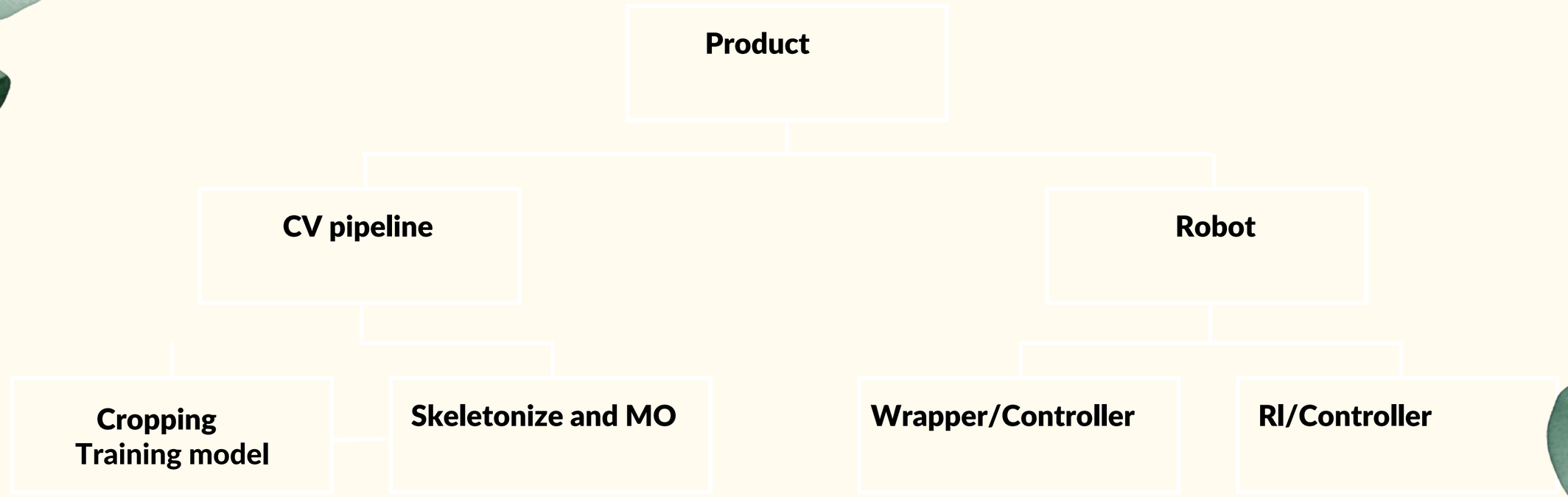
PID_Controlerr

had to revert and y and x axis in order to work

Assumptions Improvments

- 1 root per sector
- petri dish square
- top tips are in top 25 % of the image
- there is no more than 5 plants per dish

Add a Chart Page



Thank you!