1 .Back ground

INASTEK is engaged in the indoor strawberry cultivation business, which can automatically adjust the temperature, humidity and light in the room to grow strawberries even in hot regions.

Strawberries grown indoors

Machines that regulate the indoor environment

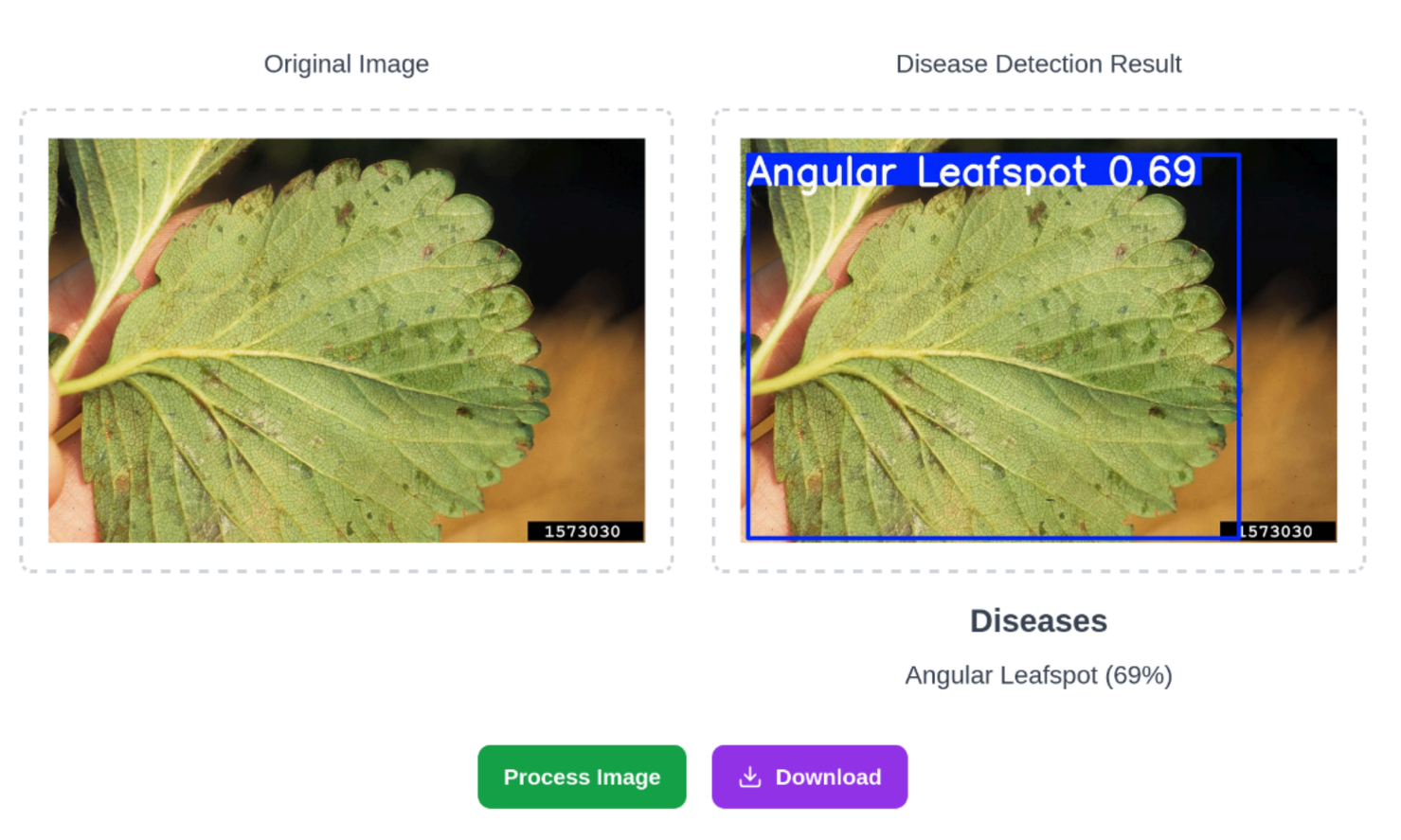
1 .Back ground

Many farmers often lack knowledge of strawberry diseases, leading to incorrect treatments that can further harm plants. AI vision technology offers early, accurate detection and precise treatment guidance to ensure optimal plant health.

Although some diseases are easy to detect with the eye, other diseases look similar so it is difficult to differentiate one disease from another.

2.Our Tasks

Develop a web application and AI Vision to detect strawberry diseases in photographs using a photo as an input image



← Example of a web app to be created

3.System Architecture

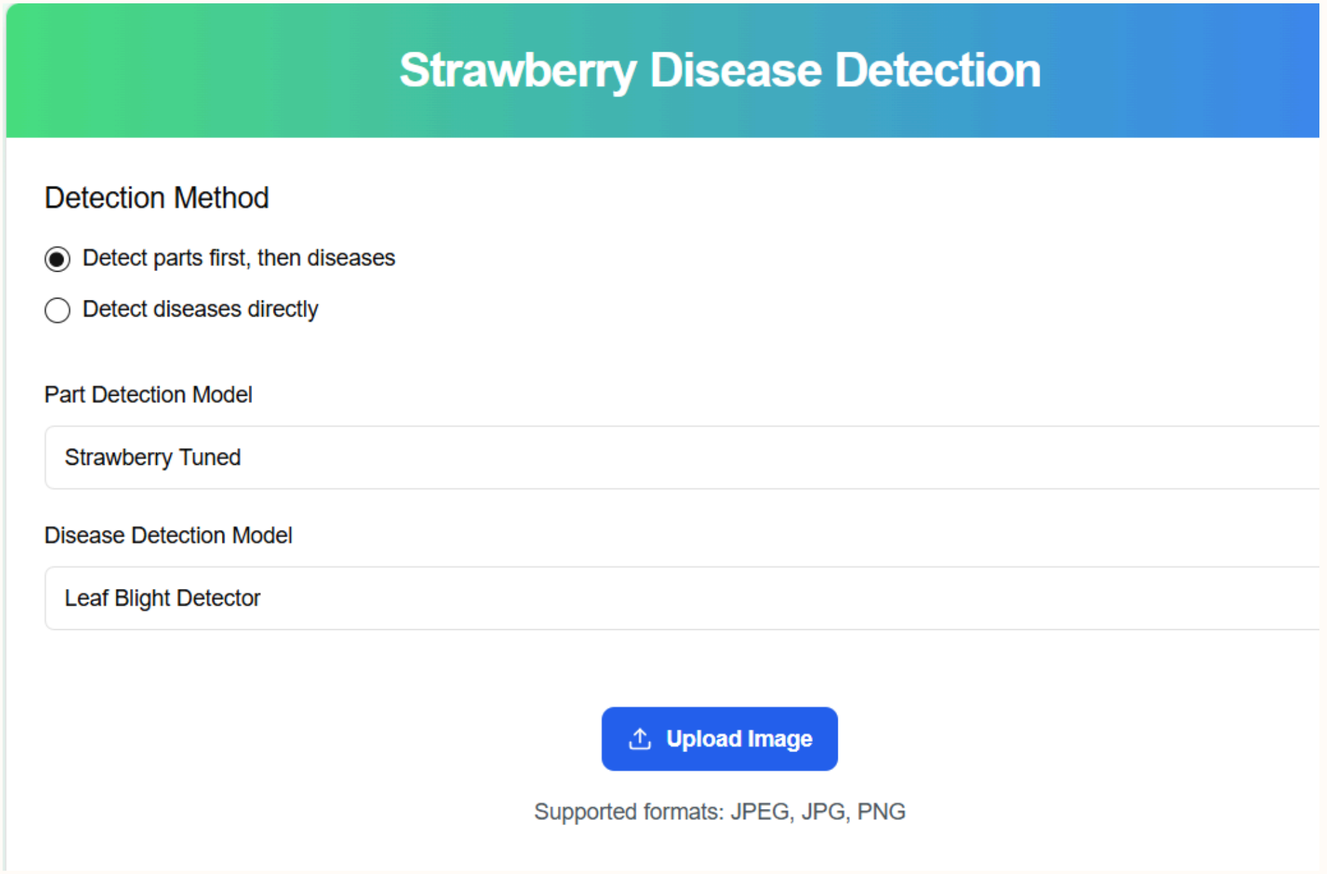
The web application employs two main approaches:

1.Two-Stage Detection:

First, a YOLO-based model detects key plant parts (leaf, fruit, flower), and then the corresponding regions (ROIs) are cropped for further analysis by a dedicated disease detection model.

2.Direct Disease Detection:

Diseases are detected directly from the entire input image without segmenting plant parts.



4.Methodology

Data Collection

- **Data Sources:**

Datasets were gathered by searching for keywords such as “strawberry disease” and the specific disease names on platforms like Roboflow.

- **Variety in Annotations:**

The collected datasets feature diverse annotation styles. Some datasets annotate only the diseased areas, while others include the outer boundaries of the plant parts (leaf, fruit, or flower).

Angular Leafspot

Blossom Blight

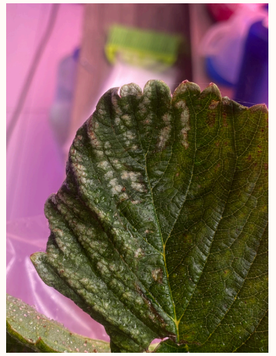
Powdery Mildew Leaf

Powdery Mildew Fruit

Gray Mold

Leaf Spot

Anthracnose Fruit Rot



mosaic viruses

Anthracnose Stem Rot

Leaf Blight

4.Methodology

Variety in Annotations:
The collected datasets feature diverse annotation styles. Some datasets annotate only the diseased areas, while others include the outer boundaries of the plant parts (leaf, fruit, or flower).

Dataset Annotation

Review of Existing Annotations:

- Existing datasets were reviewed to ensure high-quality annotations and diversity.

Manual Annotation:

- Some dataset that doesn’t annotate correctly, manually annotated.
- For diseases that are underrepresented in the strawberry datasets (e.g., Leaf Blight), manual annotations were created by outlining the infected areas using polygon shapes.
- In the case of the Mozaic Virus, annotations were adapted from a tomato plant dataset and manually refined for strawberry images.

4.Methodology

Data Cleaning and Integration
Datasets, particularly the 7-disease dataset and the Leaf Blight dataset, were merged to create a more comprehensive dataset.
Annotations were standardized across the datasets to ensure consistency during model training.

Model Training
Training Resources:
Model training was conducted using Google Colab with an A100 GPU or on a university server equipped with an Nvidia RTX 3070.

Hyperparameters:
Epochs: Between 100 and 150
Batch Sizes: 8, 16, or 32
Optimizers: SGD and AdamW
Data Augmentation: Techniques such as vertical flipping (flipud), mosaic augmentation, ,HSV, etc were applied to increase data diversity and reduce overfitting.

Part Detection Models:
- strawberry_part_detection.pt (YOLOv8n)
- strawberry_tuned.pt (YOLOv11m)

Disease Detection Models:
- best_strawberry_model.pt (YOLOv8x) – detects 7 diseases
- leafblight.pt (YOLOv8n) – detects 7 diseases plus Leaf Blight

Evaluation Metrics

The model performance was assessed using a validation dataset provided by INASTEK.

5.Results and Analysis

Detect diseases directly

model: 7 Diseases + Leaf Blight Detection

=== Accuracy results===

- Angular Leaf Spot: 66.67% (2/3)
- Anthracnose Fruit Rot: 100.00% (2/2)
- Anthracnose Stem Rot: 0.00% (0/4)
- Blossom Blight: 0.00% (0/3)
- Gray Mold: 16.67% (1/6)
- Leaf Blight: 100.00% (2/2)
- Leaf Spot: 40.00% (2/5)
- Mozaic Virus: 0.00% (0/5)
- Powdery Mildew Fruit: 100.00% (3/3)
- Powdery Mildew Leaf: 100.00% (2/2)
- Overall: 40.00% (14/35)

model: Best 7 Disease Detection

=== Accuracy results ===

- Angular Leaf Spot: 100.00% (3/3)
- Anthracnose Fruit Rot: 100.00% (2/2)
- Anthracnose Stem Rot: 0.00% (0/4)
- Blossom Blight: 0.00% (0/3)
- Gray Mold: 33.33% (2/6)
- Leaf Blight: 0.00% (0/2)
- Leaf Spot: 60.00% (3/5)
- Mozaic Virus: 0.00% (0/5)
- Powdery Mildew Fruit: 100.00% (3/3)
- Powdery Mildew Leaf: 100.00% (2/2)
- Overall: 42.86% (15/35)

5.Results and Analysis

Detect parts first, then diseases

Part Detection : Strawberry Part Detection
Disease Detection : 7 Diseases + Leaf Blight Detection7 Diseases + Leaf Blight Detection

=== Accuracy results ===

- Angular Leaf Spot: 100.00% (3/3)
- Anthracnose Fruit Rot: 100.00% (2/2)
- Anthracnose Stem Rot: 0.00% (0/4)
- Blossom Blight: 0.00% (0/3)
- Gray Mold: 33.33% (2/6)
- Leaf Blight: 100.00% (2/2)
- Leaf Spot: 40.00% (2/5)
- Mozaic Virus: 0.00% (0/5)
- Powdery Mildew Fruit: 100.00% (3/3)
- Powdery Mildew Leaf: 100.00% (2/2)
- Overall: 45.71% (16/35)

Part Detection : Strawberry Part Detection
Disease Detection : Best 7 Disease Detection

=== Accuracy results ===

- Angular Leaf Spot: 100.00% (3/3)
- Anthracnose Fruit Rot: 100.00% (2/2)
- Anthracnose Stem Rot: 0.00% (0/4)
- Blossom Blight: 0.00% (0/3)
- Gray Mold: 83.33% (5/6)
- Leaf Blight: 0.00% (0/2)
- Leaf Spot: 60.00% (3/5)
- Mozaic Virus: 0.00% (0/5)
- Powdery Mildew Fruit: 100.00% (3/3)
- Powdery Mildew Leaf: 100.00% (2/2)
- Overall: 51.43% (18/35)

5.Results and Analysis

Detect parts first, then diseases

Part Detection : Strawberry Part Detection v2
Disease Detection : 7 Diseases + Leaf Blight Detection

===Accuracy results ===

- Angular Leaf Spot: 100.00% (3/3)
- Anthracnose Fruit Rot: 100.00% (2/2)
- Anthracnose Stem Rot: 0.00% (0/4)
- Blossom Blight: 0.00% (0/3)
- Gray Mold: 66.67% (4/6)
- Leaf Blight: 100.00% (2/2)
- Leaf Spot: 40.00% (2/5)
- Mozaic Virus: 0.00% (0/5)
- Powdery Mildew Fruit: 100.00% (3/3)
- Powdery Mildew Leaf: 100.00% (2/2)
- Overall: 51.43% (18/35)

Part Detection : Strawberry Part Detection v2
Disease Detection : Best 7 Disease Detection

=== Accuracy results ===

- Angular Leaf Spot: 100.00% (3/3)
- Anthracnose Fruit Rot: 100.00% (2/2)
- Anthracnose Stem Rot: 0.00% (0/4)
- Blossom Blight: 0.00% (0/3)
- Gray Mold: 100.00% (6/6)
- Leaf Blight: 0.00% (0/2)
- Leaf Spot: 40.00% (2/5)
- Mozaic Virus: 0.00% (0/5)
- Powdery Mildew Fruit: 100.00% (3/3)
- Powdery Mildew Leaf: 100.00% (2/2)
- Overall: 51.43% (18/35)

5.Results and Analysis

Best Overall Performance:

- Three methods ("Strawberry Part Detection - Best 7 Diseases", "Strawberry Part Detection v2 - Best 7 Diseases", and "Strawberry Part Detection v2 - Leaf Blight") tied at 51.43% (18/35).
- Two-stage (part-based) approaches outperformed direct detection methods.

Disease-Specific Performance:

- 100% Detection: Angular Leaf Spot, Anthracnose Fruit Rot, and Powdery Mildew (fruit & leaf).
- Variable Detection: Gray Mold ranged from 16.67% to 100%, with best performance using Strawberry Part Detection.
- 0% Detection: Anthracnose Stem Rot, Blossom Blight, and Mozaic Virus were not detected.

Model Specialization:

- "7 Diseases + Leaf Blight Detection" models were the only ones to detect Leaf Blight.
- "Best 7 Diseases Detection" models generally achieved better results for 7 diseases.

Considerations:

- The "Strawberry Part Detection v2" approach with "Best 7 Diseases" appears most promising.

6.Drawbacks

Lack of dataset

mosaic viruses

Anthracnose Stem Rot

Low accuracy

- Unable to accommodate light color changes.
- Unable to accomodate more complex images.
- Flower often not detected
- Weak to detect blossom blight disease
- Weak to detect leaf part and the diseases of the bottom of the leaf

7. Suggestion

Suggestion for further development.

- Provide better resources to be able to conduct more experiments.
- Do better data augmentation and cleaning before training.
- Get more variant dataset.

Suggestion for using the web app.

- Take a closer photo of the affected part and then use detection method that detect disease directly.
- Take better and simpler photos.