Potato Leaf Disease Classification Using Deep Learning: A Comparative Study of Custom CNN and Transfer Learning Approaches

Deep Learning

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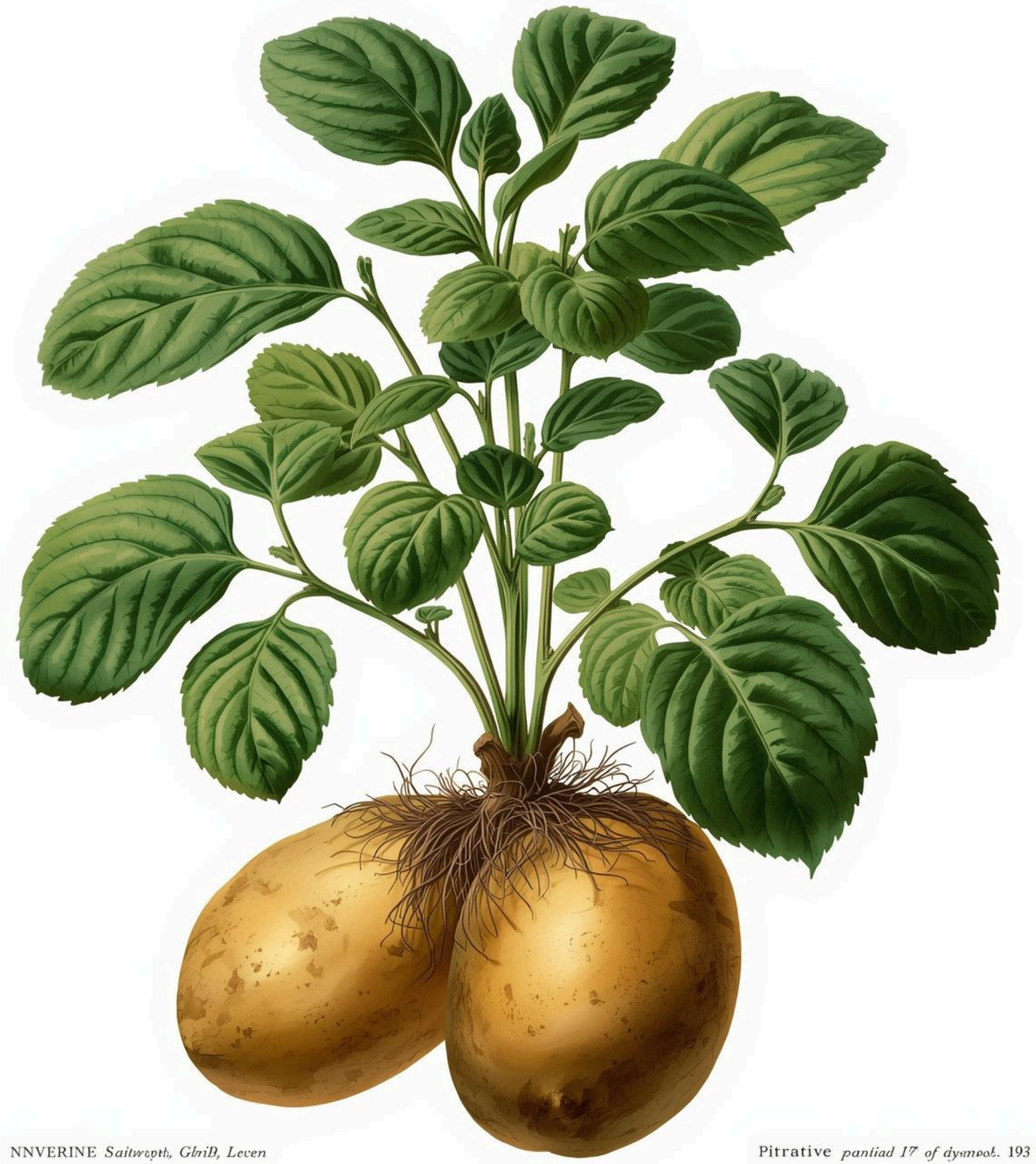
Introduction - Background

Plant diseases remain a major challenge for farmers around the world, as they can lead to significant crop losses every year.

Detecting these diseases early and accurately is crucial, yet still difficult to achieve in practice. Traditional methods such as manual inspection by agricultural experts are often slow, costly, and inconsistent.

Potato plants, in particular, are highly vulnerable to severe diseases like Early Blight and Late Blight, which can destroy an entire harvest if not identified and addressed promptly.



Problem Statement

- Limited access
- Field inspections are often labor-intensives
- Human can also be inconsistent
- Early symptoms of disease are frequently difficult to detect
- Existing conventional detection methods lacks the scalability

Deep Learning

Dataset, Data Preprocessing, Model Architecture Overview

Dataset

Total : 4072

- Early Blight : 1628 Images
- Late Blight : 1424 Images
- Healthy : 1020 Images

The dataset was divided as follow :

- Training : 3251 Images
- Validation : 416 Images
- Test : 405 Images

Data Preprocessing

- Resize 224×224

Augmentation :

- Horizontal flip
- Rotation ≤ 30°
- Adjust brightness/contrast/saturation
- Normalization (ImageNet stats)

Model Architecture Overview

Custom CNN:

- 4 convolution blocks
- FC layers: 512 → 256 → 3 classes
- Total features: 50,176

ResNet50 (Transfer Learning):

- Pretrained on ImageNet
- Freeze first 47 layers
- Custom classifier: 2048 → 512 → 3 classes

Training Setup

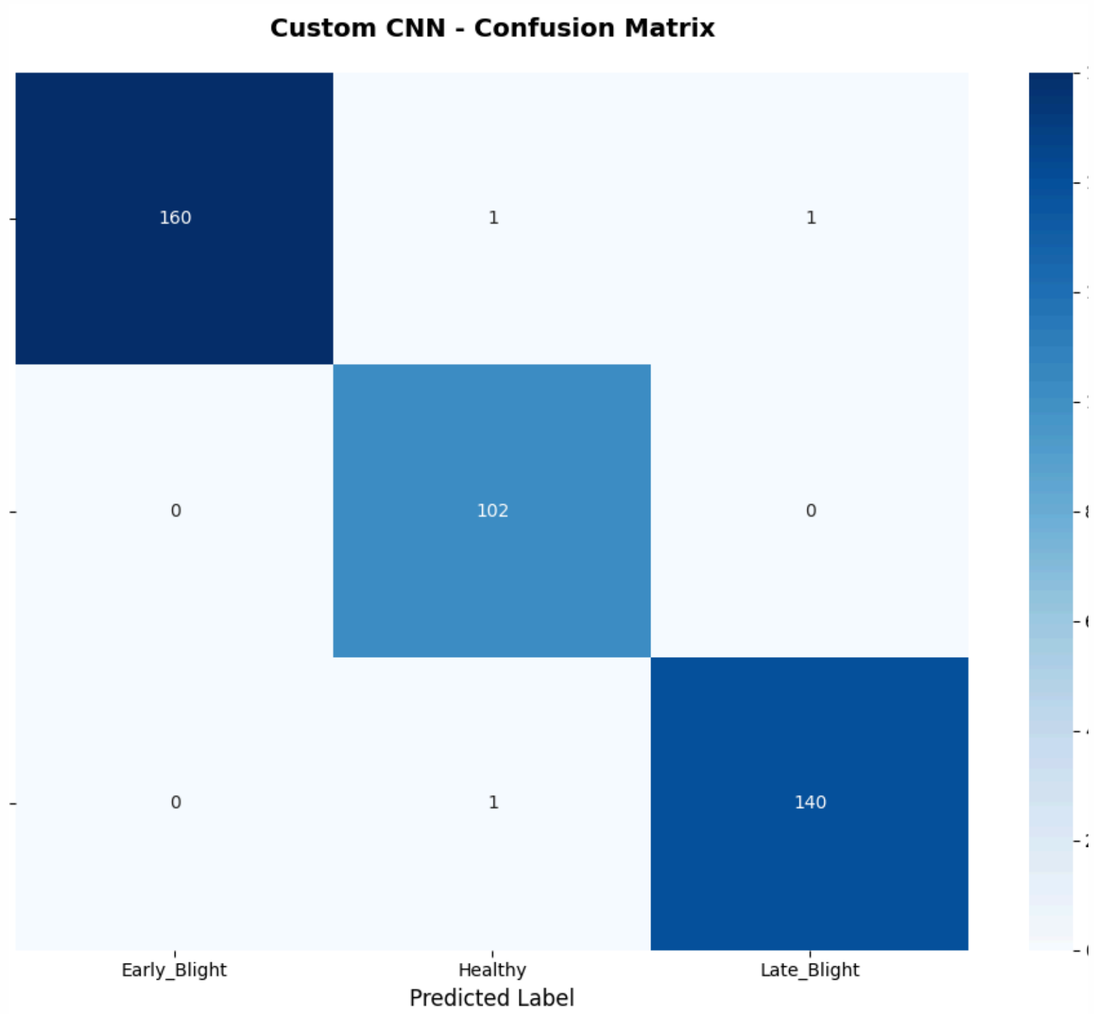
- Loss Function : CrossEntropyLoss
- Optimizer : Adam, configured with initial learning rate 0.001
- Early Stopping : Training will be halted if the validation fail to improve for 5 consecutive epochs
- Batch Size : 32
- Epochs : 50 epochs

Evaluation Matrics

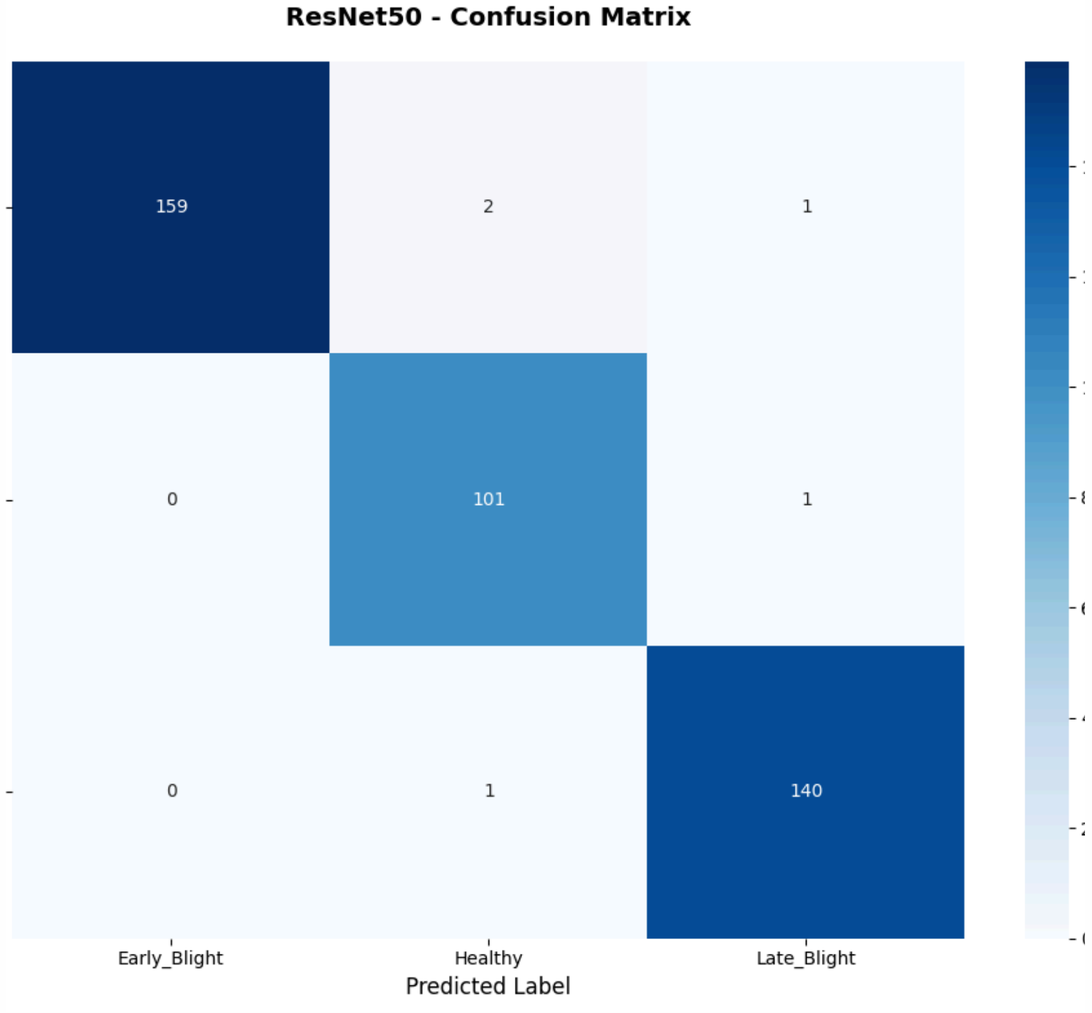
Accuracy Precision Recall F1-score Inference time Model size

Metrics	Custom CNN	ResNet50
Accuracy	9.926%	9.877%
Precision (Avg)	9.927%	9.878%
Recall (Avg)	9.926%	9.877%
F1-Score (Avg)	9.926%	9.877%
Inference time	9.51 Second	8.83 Second
Model Size	26.49 MB	93.68 MB

Confusion Matrix



Custom CNN



ResNet50

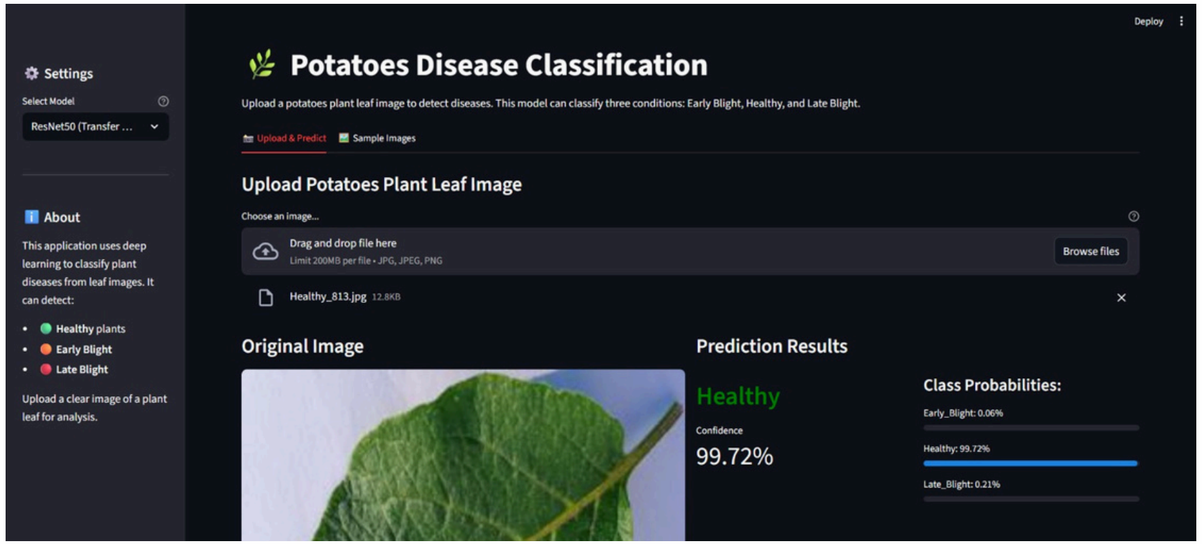
Visualization Samples

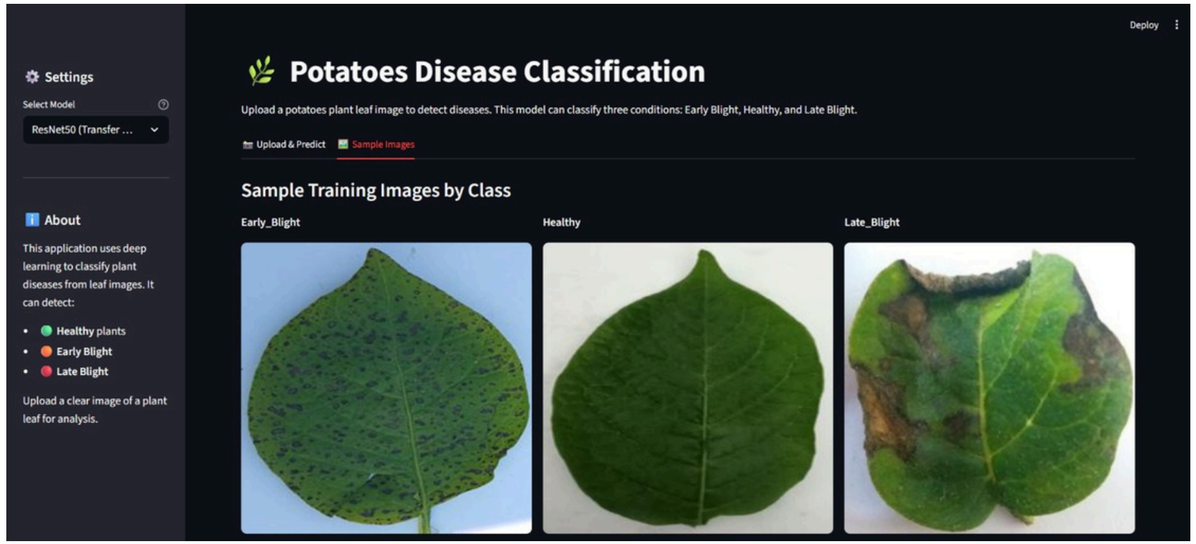
Late-Blight

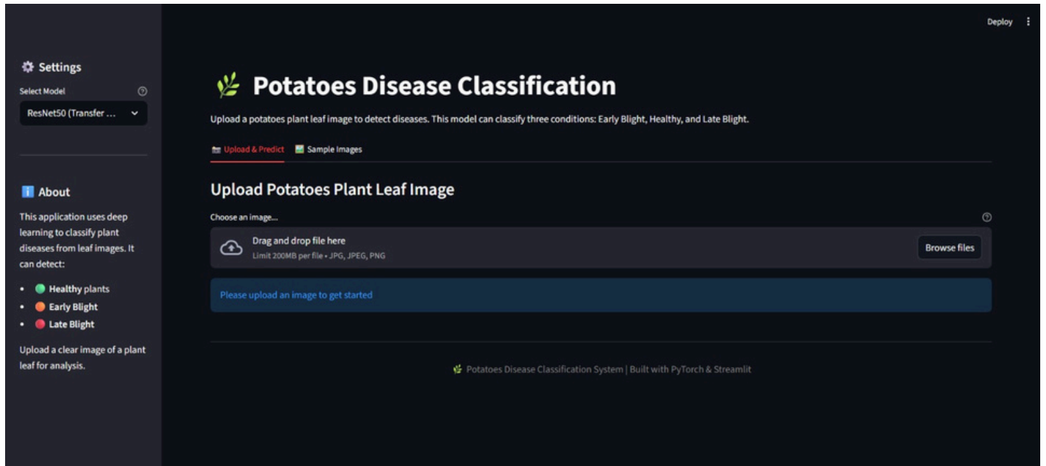
Healthy

Early-Blight

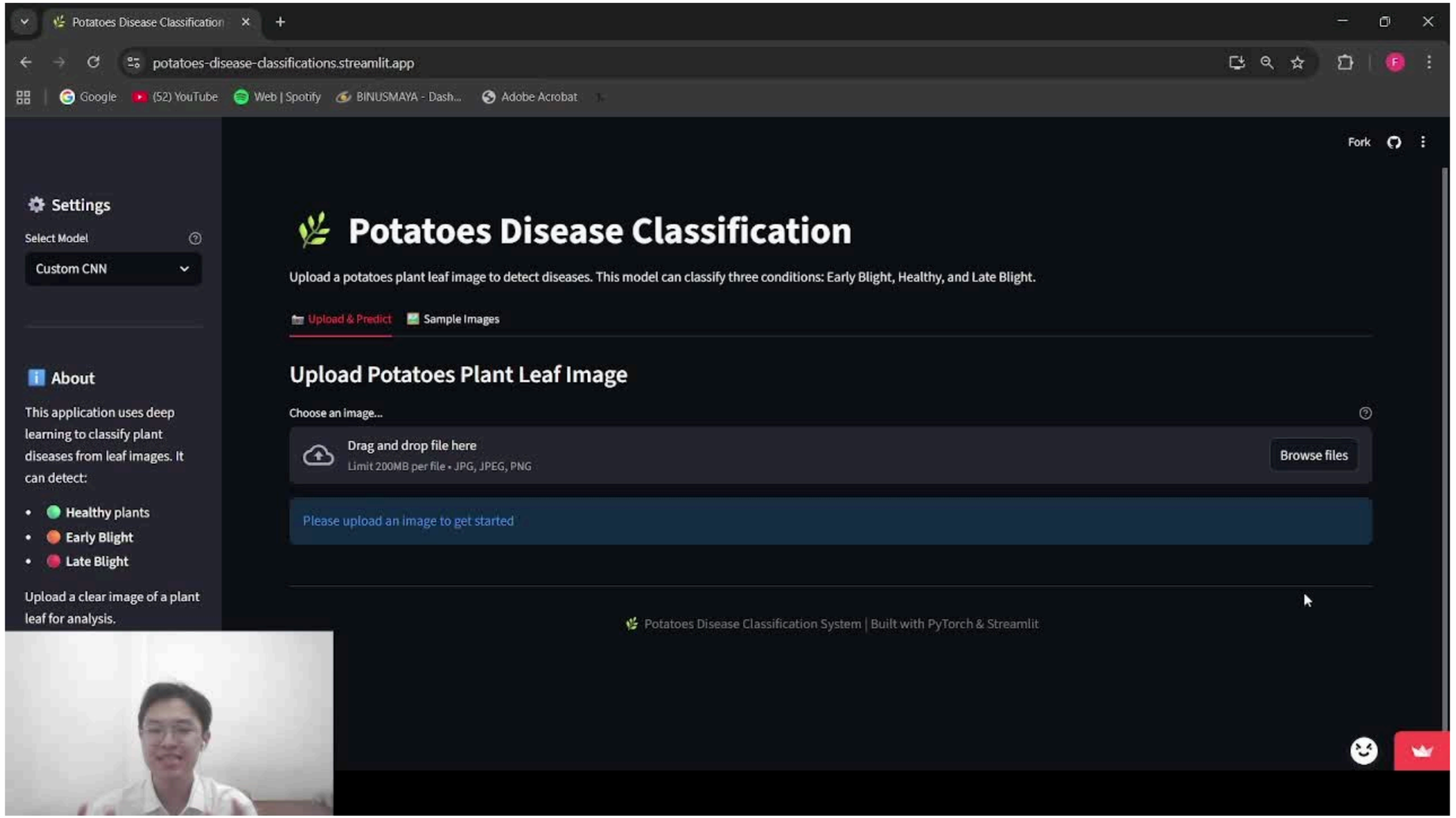
Web Application







Web Demo


Potatoes Disease Classification
potatoes-disease-classifications.streamlit.app
Google
(52) YouTube
Web | Spotify
BINUSMAYA - Dash...
Adobe Acrobat
Fork
Settings
Select Model
Custom CNN
About
This application uses deep learning to classify plant diseases from leaf images. It can detect:
Healthy plants
Early Blight
Late Blight
Upload a clear image of a plant leaf for analysis.
Potatoes Disease Classification
Upload a potatoes plant leaf image to detect diseases. This model can classify three conditions: Early Blight, Healthy, and Late Blight.
Upload & Predict
Sample Images
Upload Potatoes Plant Leaf Image
Choose an image...
Drag and drop file here
Limit 200MB per file • JPG, JPEG, PNG
Browse files
Please upload an image to get started
Potatoes Disease Classification System | Built with PyTorch & Streamlit

Reflection

Performance Analysis

The CNN model shows a more superior overall performance (99.26% vs 98.77% Accuracy).

Challenges

1.GPU Memory Constraint
2. Dataset Scale
3. Class Imbalance

Future Work

- Integration with external weather and environmental data for predictive disease risk modelling
- Development of a dedicated native mobile application for field usage
- Expansion of the model’s scope to include several crops or disease

Conclusion

The project has successfully established a highly accurate plant disease classification system for potato leaves.

The custom CNN model achieved the highest accuracy of 99.26%. On the other hand, ResNet50 were slightly less accurate (98.77%), but this model offers advantages in speed, making it a viable candidate as well.

Thank You