PlantDx

The Ultimate Mobile Plant Doctor

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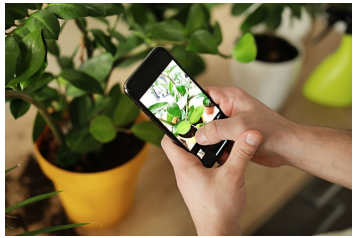
Overview

PlantDx is a modern plant doctor, using **artificial intelligence to diagnose plant health**

Upload picture



Model determines PlantDx diagnosis

Solving two key problems:

1) **Frustration** with the amount of time spent to research and diagnose plant care issues
2) **Cost** to replace dead plants and/or care for dying plants

Problem Space

Opportunity is large and growing, without clear market leader

$25bn +

US indoor plant market size, 2029

- Average **household spends** approx. **$600** on garden supplies per year
- Target market is a subset of plant owners that are **digitally-enabled** “plant parents”

67%

Adults growing or plan to grow edible plants

- House plant interest surged during pandemic
- We are betting on this **trend continuing**

47%

People reporting apprehension about purchasing plants due to care concerns ($, time, and uncertainty)

- We strive to solve this problem, **freeing up time and saving money**

Sources: Data Bridge Market Research Indoor Plants Market, Scotts Miracle-Gro and Wakefield Research, OnePoll

Project Website: plantdx.net

Demo

Dataset / EDA: PlantVillage

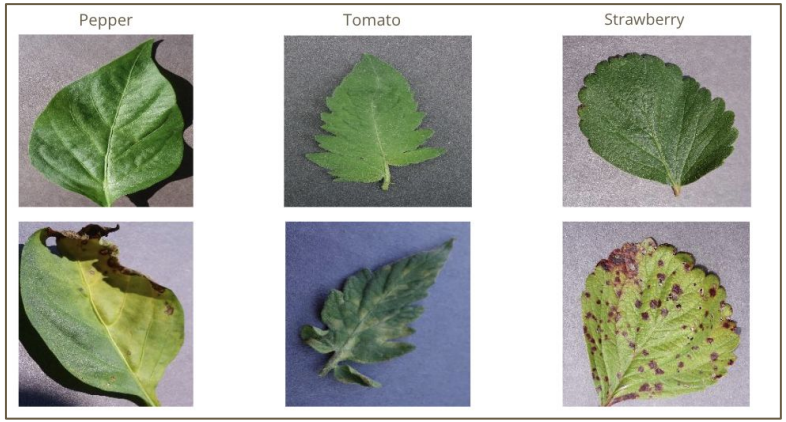
Dataset / EDA:

- ~55K w/o augmentation, ~61K w/ augmentation
- ~42K images of healthy and unhealthy labeled plant leaves
- 38 unique classes, ~25 plant types with both healthy and unhealthy labels
- Image size: 256x256

```
class_names = [
    "Apple___Apple_scab",
    "Apple___Black_rot",
    "Apple___Cedar_apple_rust",
    "Apple___healthy",
    "Blueberry___healthy",
    "Cherry_(including_sour)___Powdery_mildew",
    "Cherry_(including_sour)___healthy",
    "Corn_(maize)___Cercospora_leaf_spot Gray_leaf_spot"
    "Corn_(maize)___Common_rust_",
    "Corn_(maize)___Northern_Leaf_Blight",
    "Corn_(maize)___healthy",
    "Grape___Black_rot",
    "Grape___Esca_(Black_Measles)",
    "Grape___Leaf_blight_(Isariopsis_Leaf_Spot)",
```

Key Takeaways

- Augmentation requirements for training and generalization (lighting, brightness, etc.)
- Nuanced health characteristics
- Model best suited for image classification is CNN



Modeling approach

- Model selection
  - Focused on Convolutional Neural Networks (CNNs)
  - CNNs have become the standard model for computer vision tasks
- Experimented with 3 different CNN architectures pre-trained on ImageNet data
  - EfficientNet, MobileNet and ShuffleNet
  - Best results achieved with EfficientNet
- Transfer learning: fine-tuned all layers
- Used data augmentation to reduce model overfitting
  - Background transformation
  - The Albumentation library for several image transformations

Final Model: EfficientNet-B0

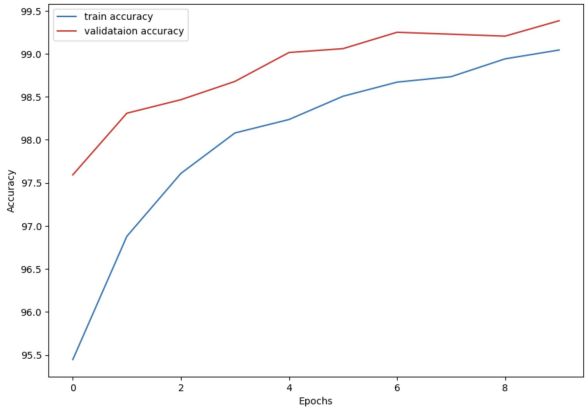
- ➢ Number of parameters: ~5.3M
- ➢ Hyperparameters
  - Optimizer: SGD
  - Learning rate: 0.001
  - Batch size: 32
  - Epochs: 10-30

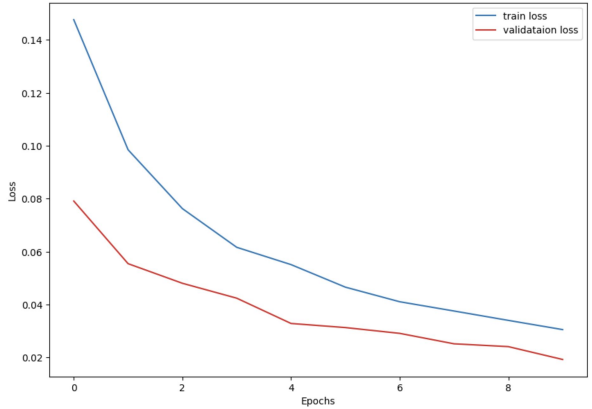
Best performance achieved with moderate data augmentation

Model Training and Evaluation

1. Training on original data
2. **Training on moderately augmented data**
3. Training on significantly augmented data

Model Performance
Trained on Moderately Augmented Data

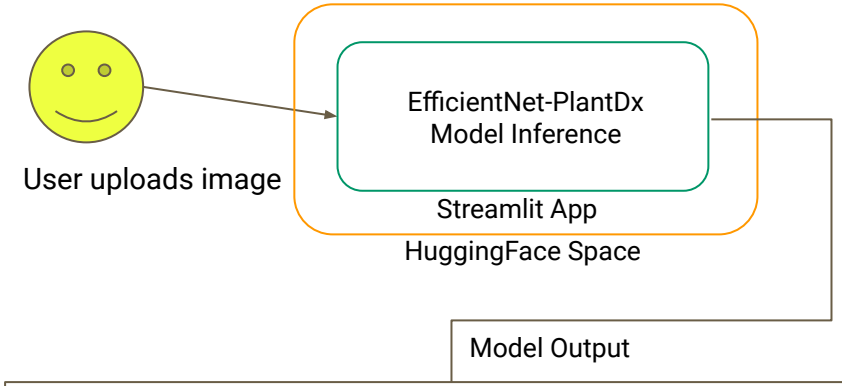




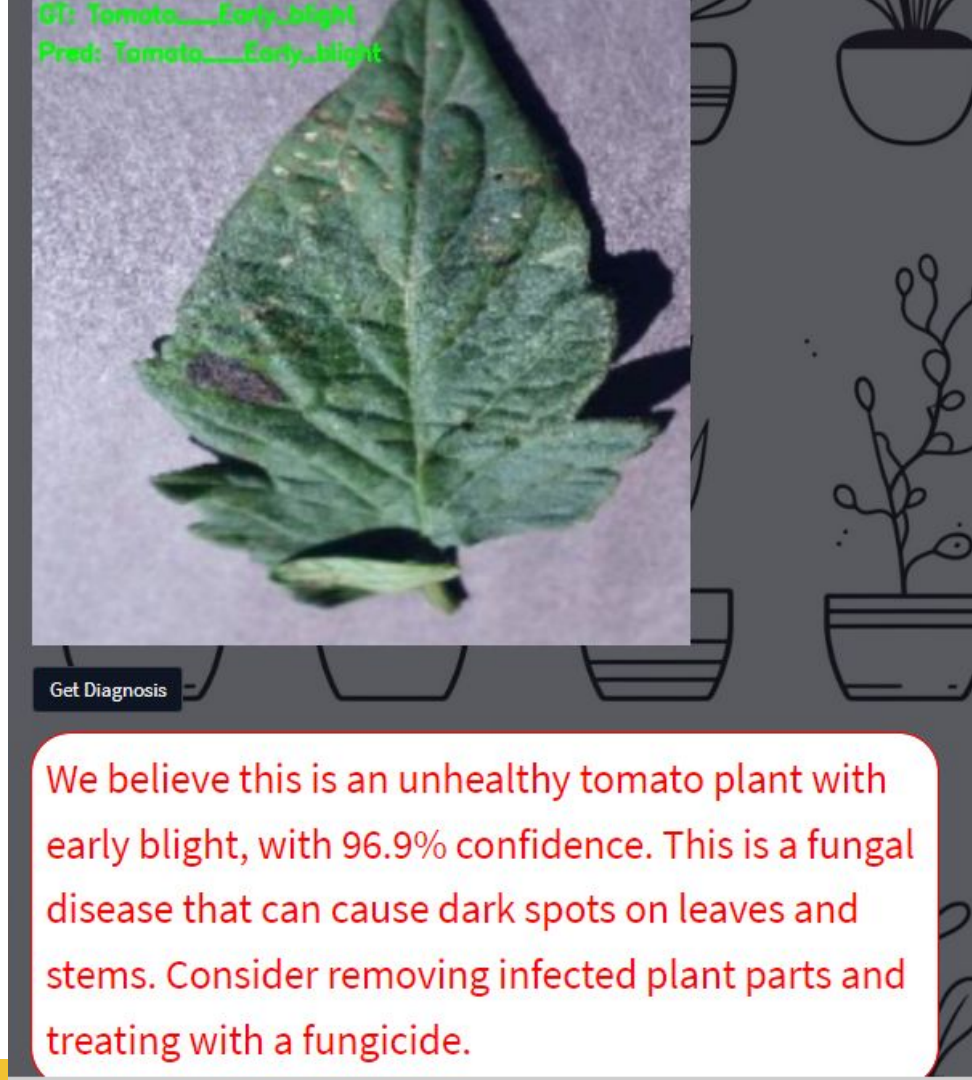
Validation Accuracy: 99.384, Validation Loss: 0.019

```
[INFO]: Epoch 10 of 10
Training
100%|██████████| 158
2/1582 [04:51<00:00,  5.42it/s]
Validation
100%|██████████| 28
0/280 [00:16<00:00, 17.39it/s]
Training loss: 0.031, training acc: 99.044
Validation loss: 0.019, validation acc: 99.384
Best validation loss: 0.019276196654547155
```

Model Architecture and Output



1. Plant Species & Health Status
2. Output Confidence (0-100%)
3. Explanation of Diagnosis
4. Actionable Treatment Plan and Recovery Procedure
5. Alternative Diagnoses (not pictured)



How did we get here?

Challenges

- Data Availability
  - Solution: Data Augmentation
- Mobile Availability
  - Solution: Mobile App
- Model Deployment
  - Solution: Web App

What's Next?

Future Work

1. Find deployment solution with greater scalability
2. Optimize model performance
3. DATA!
4. More classes (more plants and diseases)

Mission

Use machine learning to improve plant and consumer happiness outcomes

- Save users time and money
- Increase satisfaction from owning plants

Photo Source: Etsy

Q&A