# Digital Farmers:

## Harvesting Insights to Tackle Leaf Diseases

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## Introduction:

- In this project, we developed an advanced system to detect tomato leaf diseases early, leveraging machine learning and cloud technologies.
- This solution aims to help farmers reduce crop losses and pesticide usage by providing timely disease identification.

## Methodology and Achievements:

1. **Dataset Collection and Preparations:**
   - Sourced **18,160 images** from the PlantVillage dataset.
   - Applied data normalization and augmentation techniques.
2. **Model Development:**
   - Developed a **Convolutional Neural Network (CNN)** using TensorFlow and Keras.
   - Achieved **over 90% accuracy** in disease classification.
3. **Web Application development:**
   - Deployed the model and both backend and frontend servers on **Render.**
   - Created a user-friendly web application with **FastAPI** (backend) and **ReactJS** (frontend).
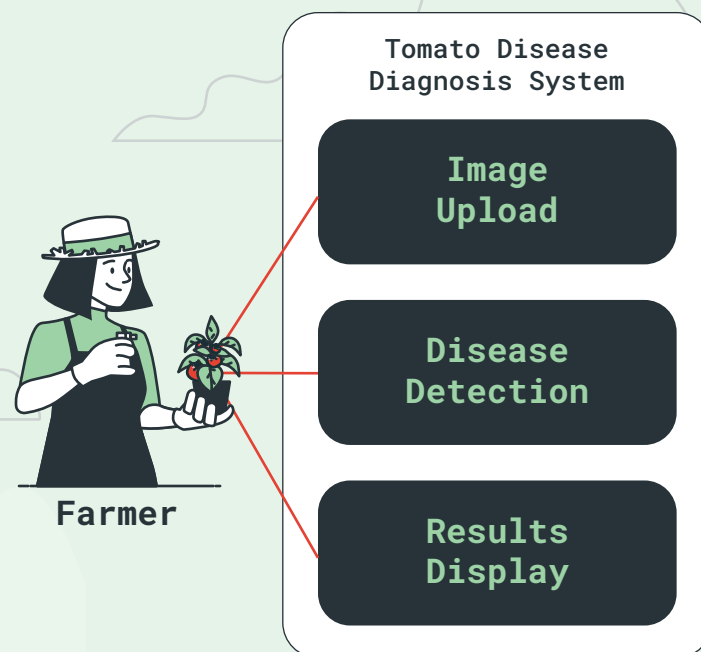
### Figure 1 - Use Case Diagram

**Tomato Disease Diagnosis System**

- Image Upload
- Disease Detection
- Results Display

**Farmer**

### Figure 2 - Training and Validation Accuracy



### Figure 3 - Confusion Matrix

**Class Index**

0 = Bacterial Spot
1 = Early Blight
2 = Late Blight
3 = Leaf Mold
4 = Septoria Leaf Spot
5 = Spiter Mites
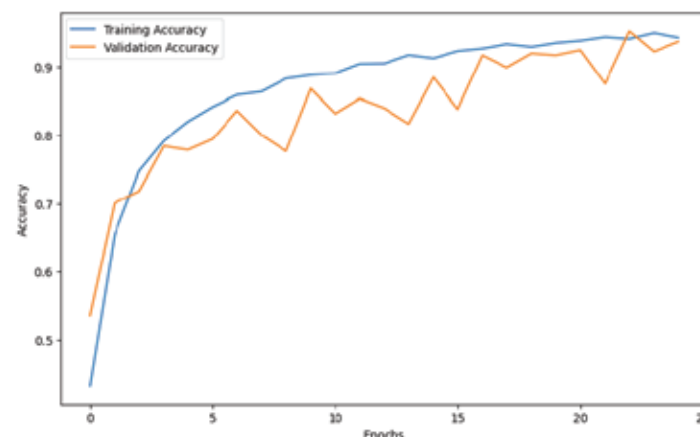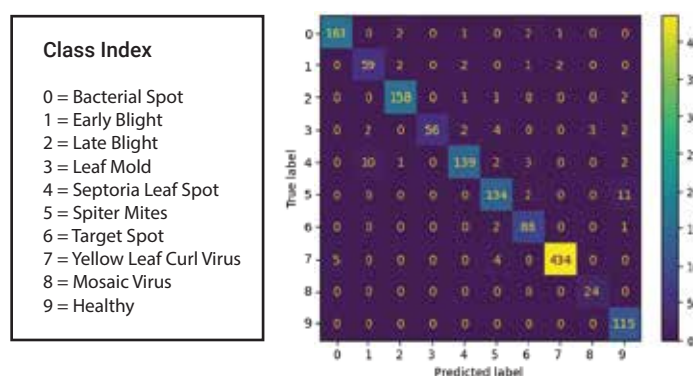6 = Target Spot
7 = Yellow Leaf Curl Virus
8 = Mosaic Virus
9 = Healthy



## Model Evaluation:

- **Model Performance:**
  - **Accuracy:** 94.2%
- **Accuracy Plot (*Figure 2*):**
  - The accuracy plot shows that the model's accuracy improved steadily over the training epochs, with both training and validation accuracy reaching over 90%. This indicates that the model learned the patterns in the data well and was able to generalize these patterns to unseen data.
- **Confusion Matrix (*Figure 3*):**
  - The confusion matrix provides a detailed breakdown of the model's performance by showing the actual vs. predicted classifications. It highlights that the model performs well in some classes but struggles in others, particularly with certain diseases that may have similar visual symptoms.

## Conclusion:

This project successfully demonstrates how integrating machine learning and cloud computing can significantly benefit agriculture by enabling early disease detection. Future enhancements include expanding the dataset, developing a mobile application, and incorporating additional features to support various crop types.