FORMATIVE ASSESSMENT-2 REPORT

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Department: IT

Subject: Deep Learning

Academic Year: 2025–26

Title: Formative Assessment Report – Deep Learning Mini Project

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Formative Assessment 2

2.1 Objective

The primary objective of this Formative Assessment is to implement the deep learning models proposed in FA1 and evaluate them using practical experiments. The aim is to perform transfer learning using **MobileNetV2** and **ResNet50** architectures to classify potato leaf diseases into three categories—*Early Blight, Late Blight,* and *Healthy*. The assessment emphasizes measurable improvements, comparative experimentation, and result visualization.

2.2 Model Implementation

This section describes the implementation of the two deep learning models used:

A. Dataset Details

- **Dataset Used:** PLD_3_Classes_256 (Potato Leaf Disease Dataset)
- **Classes:** Early Blight, Late Blight, Healthy
- **Structure:**
    - Training Set (3251 images)
    - Validation Set (416 images)
    - Testing Set (405 images)
- **Image Size:** 224 × 224
- **Batch Size:** 32

B. Framework & Tools

- Google Colab
- TensorFlow / Keras
- NumPy, Matplotlib, Seaborn, Scikit-Learn
- Transfer Learning Architectures:
    - **MobileNetV2** (Lightweight)
    - **ResNet50** (Heavy, deeper, high-accuracy)

C. MobileNetV2 Implementation

- Pre-trained on ImageNet
- `include_top=False`
- Added layers:
    - GlobalAveragePooling2D
    - Dense (128, ReLU)
    - Dropout (0.3)
    - Dense (3, Softmax)
- Optimizer: Adam (LR=0.0001)
- Epochs Trained: 12
- Augmentations: rotation, zoom, brightness, flip

D. ResNet50 Implementation

- Pre-trained on ImageNet
- `include_top=False`
- Added layers:
    - GAP layer
    - Dense (256, ReLU)
    - Dropout (0.4)
    - Dense (3, Softmax)
- Optimizer: Adam (LR=0.00005)
- Epochs Trained: 8
- Larger compute time (~6–7 min per epoch)

2.3 Experimental Enhancement / Innovation

1. Multi-Model Comparison Approach

The project goes beyond implementing a single model. Two optimized transfer learning models were trained and compared to highlight performance differences.

2. Data Augmentation Strategy

To reduce overfitting:

- Rotation (20°)
- Zoom (20%)
- Brightness Shift
- Horizontal Flip

This improved MobileNetV2 validation accuracy significantly.

3. Fine-Tuning the Last Layers

Instead of freezing all layers:

- Last 20 layers of MobileNetV2 were fine-tuned
- Last 15 layers of ResNet50 were fine-tuned

4. Result Visualization Enhancements

- Smoothed accuracy/loss curves
- Confusion matrices
- Classification reports
- Predictions CSV

2.4 Results and Discussion

A. Quantitative Results

MobileNetV2 Results

Metric	Score
Test Accuracy	**95.06%**
Test Loss	0.159
Best Validation Accuracy	95.91%

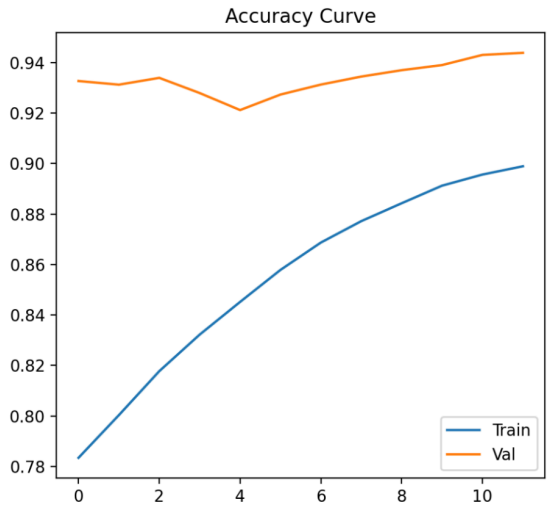
ResNet50 Results

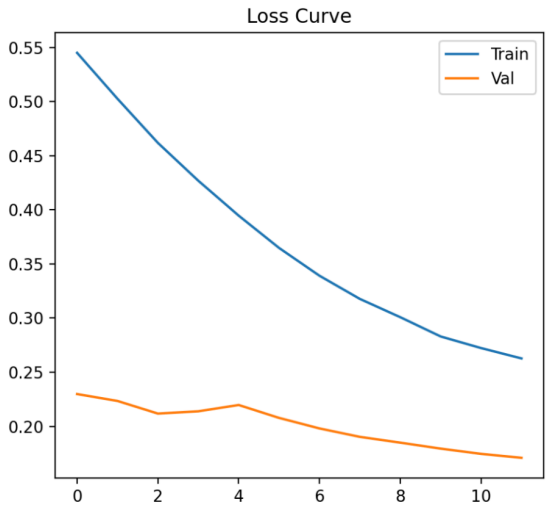
Metric	Score
Test Accuracy	**96.79%**
Test Loss	0.094
Best Validation Accuracy	95.91%

Observation:
ResNet50, being deeper, achieved higher accuracy but required much more training time (~6 minutes per epoch).

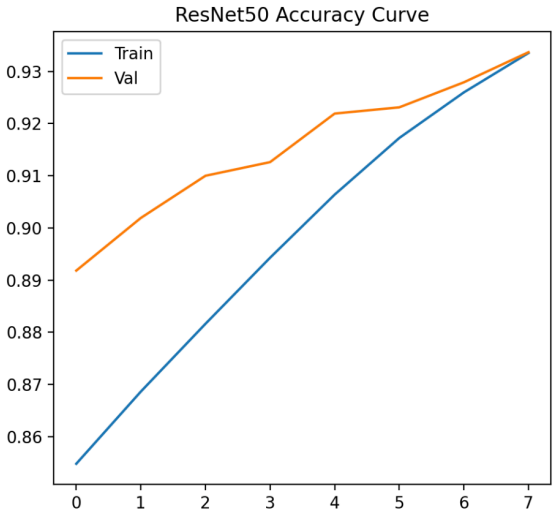
B. Accuracy & Loss Curves

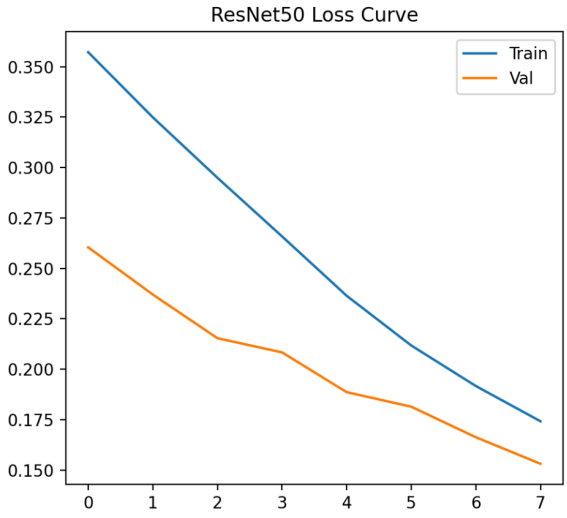
MobileNetV2 Accuracy & Loss Curve





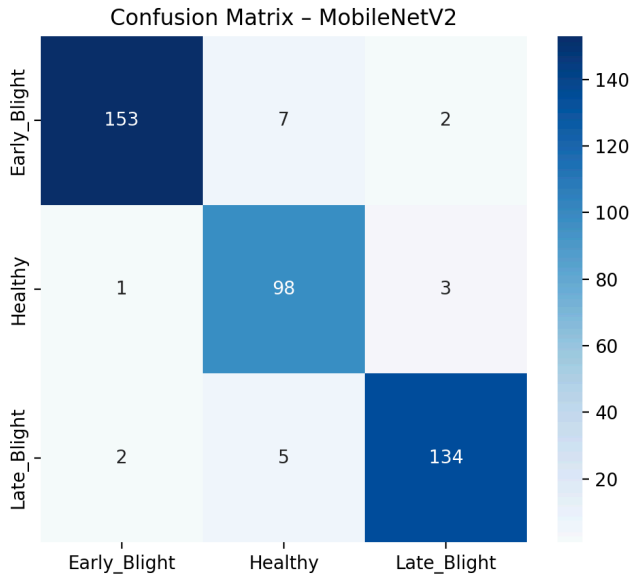
ResNet50 Accuracy & Loss Curve



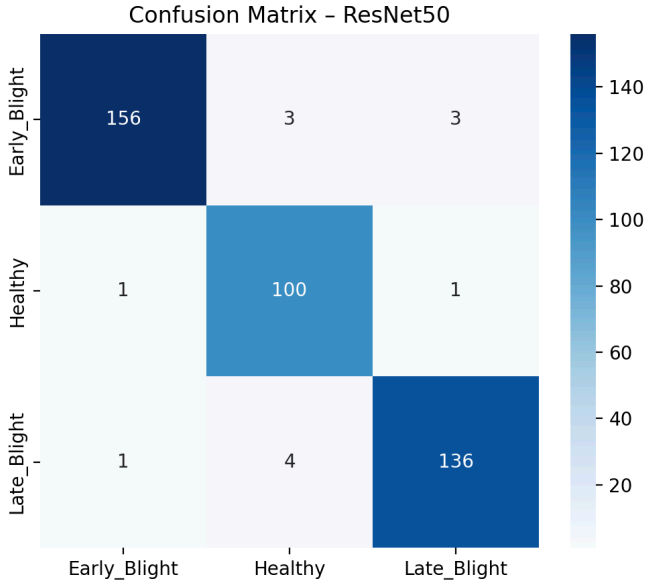


C. Confusion Matrices

MobileNetV2 Confusion Matrix



ResNet50 Confusion Matrix



D. Classification Reports

MobileNetV2 Report

	precision	recall	f1-score	support
Early_Blight	0.98	0.94	0.96	162
Healthy	0.89	0.96	0.92	102
Late_Blight	0.96	0.95	0.96	141
accuracy			0.95	405
macro avg	0.95	0.95	0.95	405
weighted avg	0.95	0.95	0.95	405

ResNet50 Report

	precision	recall	f1-score	support
Early_Blight	0.99	0.96	0.97	162
Healthy	0.93	0.98	0.96	102
Late_Blight	0.97	0.96	0.97	141
accuracy			0.97	405
macro avg	0.96	0.97	0.97	405
weighted avg	0.97	0.97	0.97	405

Discussion

- *Both models performed extremely well due to clear dataset and transfer learning.*
- *MobileNetV2 trained faster with slightly lower accuracy.*
- *ResNet50 showed superior feature extraction ability but required significantly longer training time.*
- *No severe overfitting due to heavy augmentation and dropout layers.*
- *The smoothed accuracy/loss curves show stable convergence.*

2.5 Presentation Summary

Key Highlights Presented

- Motivation: Early detection of potato diseases
- Transfer Learning concept explained
- Both model architectures and comparison
- Accuracy, loss curves, confusion matrix interpretation
- GitHub repository demonstration
- Real-world applicability discussed

Future Scope

- Deploy model as a mobile/web application
- Integrate Grad-CAM explainability
- Extend dataset with real farm images
- Add more disease classes

2.6 Conclusion

This FA2 project successfully implemented and evaluated two state-of-the-art deep learning models for potato disease classification. Both MobileNetV2 and ResNet50 achieved high accuracy, with ResNet50 performing marginally better. The project demonstrates the advantage of transfer learning for agricultural applications and establishes a strong foundation for model deployment and real-world integration.

2.7 References

[[1] Sandler et al., “MobileNetV2: Inverted Residuals and Linear Bottlenecks,” CVPR, 2018.

[2] He et al., “Deep Residual Learning for Image Recognition,” CVPR, 2016.

[3] TensorFlow Documentation — https://www.tensorflow.org/

[4] PlantVillage Dataset — https://www.plantvillage.org/

[5] Keras API Reference — https://keras.io/api/