

Project Development Phase

Model Performance Test

Project Development Phases with Model Performance Focus

1. Problem Definition & Requirement Analysis

- **Goal:** Classify fruits/vegetables as *rotten* or *fresh*.
 - **Success Metric:** High precision and recall for *rotten* detection (important to avoid selling bad produce).
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2. Data Collection

- **Sources:**
 - Kaggle datasets (e.g., [Fruits 360, Rotten Fruits Image Dataset]).
 - Field data collection (smartphone/camera images).
- **Data Types:** Images with labels (*fresh*, *rotten*, sometimes per fruit type).

✓ **Key Performance Need:** Diverse, high-quality images directly affect model performance.

3. Data Preprocessing

- Resize all images to a fixed size (e.g., 224x224).
- Label encoding (e.g., 0 = fresh, 1 = rotten).

- Data augmentation:
 - Rotation, zoom, flip, brightness adjustment.

✓ *Impact:* Helps improve **generalization** and reduces **overfitting**.

4. Model Selection

Choose models based on computational power and dataset size:

- **Baseline:** Simple CNN (3 conv layers)
- **Advanced:** Transfer learning (VGG16, ResNet50, MobileNet)

✓ *Model Performance Tuning Begins:* Compare training speed, accuracy, and loss.

5. Training and Validation

- Split: 70% train, 15% validation, 15% test
- Use **Adam optimizer**, **cross-entropy loss**
- Track:
 - **Training & validation accuracy**
 - **Training & validation loss**
 - Use **early stopping**

Example:

Epoch	Train Acc	Val Acc	Train Loss	Val Loss
1	65%	62%	0.89	0.91
10	92%	90%	0.23	0.27
20	96%	93%	0.08	0.12

6. Model Evaluation

- Use **confusion matrix, classification report**:
 - **Precision, Recall, F1-score**
 - Focus on:
 - **Recall for "rotten" class** (to avoid missing bad produce)
 - **F1-score** (balance between precision & recall)

Good model performance:

- F1-score > 90%
 - Accuracy > 92%
 - High Recall for rotten (>95%)
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7. Deployment

- Convert model to **TensorFlow Lite / ONNX** for mobile or edge device.

- Create a web or mobile app interface.
 - Integrate with camera hardware for real-time predictions.
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8. Monitoring & Feedback

- Track real-world predictions vs actual rot.
 - Re-train with new data periodically to handle:
 - New fruit types
 - Changing conditions (light, temperature, etc.)
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Summary Table

Phase	Performance Focus
Data Preprocessing	Image quality, class balance
Model Training	Accuracy, loss curves, overfitting control
Evaluation	Confusion matrix, Precision, Recall, F1
Deployment	Inference speed, real-time accuracy
Feedback	Continuous improvement via new data