

## **SMART SORTING : TRANSFER LEARNING FOR IDENTIFYING ROTTEN FRUITS AND VEGETABLES**

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## **CHAPTER-7**

### **7.1 FUNCTIONAL AND PERFORMANCE TESTING**

**SMART SORTING:** Transfer Learning for Identifying Rotten Fruits and Vegetables:

Testing plays a crucial role in ensuring that the SMART SORTING system functions correctly, delivers accurate predictions, and performs efficiently under real-world conditions. The testing process is divided into Functional Testing and Performance Testing to validate both system behavior and operational efficiency.

#### **❖ Functional Testing:**

Functional testing verifies whether each component of the system works according to the specified requirements. It ensures that the image classification pipeline, from input to output, operates correctly.

#### **✓ Input Validation Testing:**

This test ensures that the system correctly accepts valid image formats such as JPG and PNG and rejects unsupported or corrupted files. It verifies that the application handles incorrect inputs gracefully without crashing.

#### **✓ Image Preprocessing Testing:**

The preprocessing module is tested to confirm that images are properly resized, normalized, and augmented before being passed to the model. The system is checked to ensure that preprocessing maintains image integrity and consistency.

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### **✓ Model Classification Testing:**

The trained transfer learning model using frameworks such as TensorFlow or PyTorch is tested with known labeled images. The predicted output is compared with actual labels to verify classification correctness for categories such as fresh and rotten produce.

### **✓ Output Verification Testing:**

This test ensures that the system displays correct predictions along with confidence scores. In industrial setups, it verifies that the classification output correctly triggers sorting mechanisms such as actuators or robotic arms.

### **✓ Integration Testing:**

Integration testing confirms that all modules—image acquisition, preprocessing, model inference, and output display—work together seamlessly. It ensures smooth communication between the front-end interface and backend prediction API.

### **✓ Error Handling Testing:**

The system is tested under abnormal conditions such as poor lighting images, blurred images, or partial object visibility to verify that it handles errors without failure and provides meaningful feedback.

### **❖ Performance Testing:**

Performance testing evaluates the efficiency, speed, scalability, and reliability of the system under different operating conditions.

### **✓ Accuracy Testing:**

Model performance is evaluated using metrics such as accuracy, precision, recall, F1-score, and confusion matrix analysis. Pre-trained models like MobileNetV2 or ResNet50 are analyzed to ensure they meet the target accuracy threshold.

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### **✓ Response Time Testing:**

The system is tested to measure how quickly it processes an image and generates a prediction. For real-time applications, inference time must remain within acceptable limits to support continuous sorting operations.

### **✓ Load Testing:**

Load testing determines how the system performs when multiple images are processed simultaneously. This is especially important for web-based deployments or large-scale industrial applications.

### **✓ Stress Testing:**

Stress testing evaluates system stability under extreme conditions such as high image input rates or limited hardware resources. It identifies breaking points and ensures system reliability.

### **✓ Scalability Testing:**

This testing verifies whether the system can handle an increased number of fruit and vegetable categories without significant degradation in performance.

### **✓ Deployment Environment Testing:**

The system is tested in different environments, including local machines, cloud platforms, and edge devices, to ensure consistent performance across deployment platforms.

In conclusion, functional testing ensures that the SMART SORTING system performs its intended tasks accurately, while performance testing guarantees efficiency, reliability, and scalability. Together, these testing strategies validate that the system is robust, accurate, and ready for real-world implementation in agricultural and retail environments.