Chapter 11

11.1 FUTURE SCOPE

SMART SORTING: Transfer Learning for Identifying Rotten Fruits and Vegetables

The SMART SORTING system establishes a strong foundation for intelligent food quality assessment, and its future scope is extensive across technological, industrial, and research domains.

- **Expansion to More Crop Varieties:**

Currently, the system focuses on selected fruits and vegetables. In the future, it can be extended to cover a wider range of produce including leafy vegetables, exotic fruits, and region-specific crops. By continuously updating the dataset and retraining models such as MobileNetV2 and ResNet50, the system can support multi-class classification for diverse agricultural products.

- **Detection of Internal Spoilage:**

The present system identifies only visible surface defects. Future enhancements may include integration with advanced imaging technologies such as hyperspectral imaging, X-ray imaging, or near-infrared sensors to detect internal decay and hidden contamination. This would significantly improve reliability in quality inspection.

- **Integration with IoT and Smart Agriculture:**

The system can be integrated with IoT-enabled conveyor belts, robotic arms, and automated packaging units for fully autonomous sorting in large-scale food processing industries. Real-time monitoring dashboards can be developed for remote supervision of sorting operations in warehouses and cold storage facilities.

- **Edge and Mobile Deployment:**

Future development can focus on lightweight model optimization for deployment on edge devices such as embedded systems or smartphones. This

would allow farmers and vendors to use the system directly in fields or marketplaces without requiring high-end computing infrastructure.

- **Cloud-Based Analytics and Data Insights:**

By integrating with cloud platforms, the system can store classification results and generate analytical reports. Data analytics can help identify spoilage patterns, seasonal quality variations, and supply chain inefficiencies. Such insights can support decision-making in inventory management and logistics.

- **Real-Time Video Processing:**

Instead of single image classification, the system can be upgraded to process real-time video streams. This enhancement would allow continuous monitoring and automatic sorting of produce moving on conveyor belts in high-speed industrial environments.

- **AI Model Improvement and Hybrid Techniques:**

Future versions may combine transfer learning with other AI approaches such as ensemble learning or attention-based deep learning models to improve classification accuracy. Advanced architectures beyond models like VGG16 could be explored to achieve better performance with reduced computational cost.

- **Integration with Supply Chain Management Systems:**

The system can be connected with enterprise resource planning and inventory systems to automatically update stock quality records. This integration would streamline operations from farm to retail distribution.

In summary, the SMART SORTING system has strong potential for technological expansion and industrial adoption. With advancements in AI, IoT, and smart agriculture technologies, it can evolve into a comprehensive automated quality inspection and food management solution for the future.