

# Smart Sorting: Transfer Learning for Identifying Rotten Fruits and Vegetables

## Abstract

This project presents a smart sorting system using transfer learning to identify rotten and fresh fruits and vegetables. The goal is to automate quality control in agriculture and food industries by utilizing pre-trained deep learning models such as MobileNetV2. The model is fine-tuned using a dataset of labeled images and integrated into a simple web application.

## Introduction

Manual sorting of fruits and vegetables is time-consuming and error-prone. This project proposes a deep learning approach that leverages transfer learning to detect freshness in produce with high accuracy. It combines computer vision, transfer learning, and web development for real-time usage.

## Dataset Description

The dataset contains images of various fruits and vegetables, categorized into 'Fresh' and 'Rotten' classes. It includes apples, bananas, tomatoes, etc. The images are resized and augmented for training. Data is split into 80% training and 20% validation subsets.

## Methodology

We used MobileNetV2, a lightweight CNN model pre-trained on ImageNet, as our base model. Its top layers were removed and replaced with a custom classification head. The model was trained using binary cross-entropy loss and Adam optimizer. Image augmentation techniques like rotation, flipping, and zooming were used to improve robustness.

## Model Architecture

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1. Input Layer: 224x224 RGB images
2. Base Model: MobileNetV2 (frozen weights)
3. Global Average Pooling Layer
4. Dense Layer with ReLU
5. Output Layer with Sigmoid activation

The model outputs a probability score for freshness classification.

## Results

The model achieved over 95% accuracy on the validation set. Loss and accuracy curves indicate good convergence. Sample test results show high reliability across different fruits and lighting conditions.

## Web Deployment

The trained model was integrated into a Flask web app. Users can upload images, and the model predicts whether the fruit or vegetable is fresh or rotten. The app uses HTML for frontend and Python for backend inference.

## Conclusion & Future Work

This project demonstrates the efficiency of transfer learning in agricultural automation. Future improvements include expanding to multiclass classification, deploying on mobile devices, and using real-time video streams. Additionally, Grad-CAM can be used to visualize model focus areas.