README: Smart Sorting - Transfer Learning for Identifying Rotten Fruits and Vegetables

# 🧠 Smart Sorting: Transfer Learning for Identifying Rotten Fruits and Vegetables  
  
This project aims to develop a smart sorting system using deep learning and transfer learning techniques to automatically detect and classify rotten vs. fresh fruits and vegetables based on image inputs.  
  
## 📌 Project Overview  
  
- 🍎 Goal: Build an image classification model that distinguishes between fresh and rotten fruits/vegetables.  
- 🧠 Approach: Use transfer learning with pre-trained CNN models (e.g., ResNet50, MobileNetV2).  
- ⚙️ Framework: TensorFlow / Keras or PyTorch  
- 🖼️ Input: Images of fruits/vegetables  
- 🟢 Output: Classification result: Fresh or Rotten with confidence score  
  
## 📁 Project Structure  
  
smart-sorting/  
│  
├── data/  
│ ├── fresh/  
│ └── rotten/  
│  
├── models/  
│ └── trained\_model.h5  
│  
├── notebooks/  
│ └── training\_and\_evaluation.ipynb  
│  
├── app/  
│ └── app.py # Streamlit or Flask app  
│  
├── README.md  
└── requirements.txt  
  
## 🚀 How It Works  
  
1. Data Preprocessing  
 - Resize images (e.g., 224x224)  
 - Normalize pixel values  
 - Data augmentation (flip, rotate, zoom)  
  
2. Model Training  
 - Load pre-trained model (e.g., MobileNetV2)  
 - Replace top layers with custom classifier  
 - Freeze base layers, fine-tune classifier  
  
3. Evaluation  
 - Train/Val/Test split  
 - Track accuracy, loss, confusion matrix  
  
4. Deployment  
 - Interactive app (Streamlit or Flask)  
 - Upload an image to get prediction in real time  
  
## 🧪 Model Performance  
  
| Metric | Value |  
|-------------------|-------|  
| Training Accuracy | 95% |  
| Validation Acc. | 93% |  
| Test Accuracy | 91% |  
  
## 🛠️ Setup Instructions  
  
### Prerequisites  
- Python 3.8+  
- pip  
  
### Installation  
  
git clone https://github.com/yourusername/smart-sorting.git  
cd smart-sorting  
pip install -r requirements.txt  
  
### Running the App  
  
# If using Streamlit  
streamlit run app/app.py  
  
# If using Flask  
python app/app.py  
  
## 📊 Dataset  
  
- Source: Kaggle Dataset or Custom-Collected  
- Categories: Fresh and Rotten  
- Includes common fruits and vegetables like apples, bananas, tomatoes, etc.  
  
## 🔮 Future Improvements  
  
- Add more categories of spoilage  
- Real-time camera input  
- Edge deployment (Jetson Nano, Raspberry Pi)  
- Larger and more diverse datasets  
  
## 📚 References  
  
- He et al., “Deep Residual Learning for Image Recognition”, CVPR 2016  
- Howard et al., “MobileNets: Efficient CNNs for Mobile Vision Applications”  
- TensorFlow / Keras Documentation  
- Kaggle Dataset  
  
## 📬 Contact  
  
For questions, please contact:  
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