NAME:THATIPARTHI VINAY RAJ

REGISTER NUMBER :113323104220

NMID: aut113323csd55

PROJECT TITLE: AI-EBPL-Quality Control in Manufacturing

GROUP MEMBERS: VINOTHANA.B,SUSANTH KUMAR SINGH DINANTH,THATIPARTHI VINAY RAJ,THIRUSH BALAJI.S,AJAY.P

Phase 3: Implementation of Project

# Title: Smart Freshness Detector for Fruits and Vegetables using AI and IoT

## Objective

The goal of Phase 3 is to implement the core components of the Smart Freshness Detector. This includes developing the image classification AI model, integrating environmental sensors (like DHT11), deploying the application on a user interface (Streamlit), and ensuring proper handling of sensor and image data.

## 1. AI Model Development

**Overview**  
 The AI component plays a central role in detecting the freshness of fruits and vegetables by analyzing images for quality degradation patterns

**Implementation**

* Model: A Convolutional Neural Network (CNN) trained on a dataset of fruits and vegetables with labels such as fresh, moderately fresh, and spoiled.
* Preprocessing: Input images are resized, normalized, and augmented to enhance model accuracy.
* Training: The model is trained using TensorFlow/Keras on labeled datasets and validated to ensure generalization.
* Integration: The trained model is integrated into the application pipeline for real-time image evaluation.

**Outcome** By the end of Phase 3, the AI should classify fruit and vegetable freshness with reasonable accuracy based on the visual input provided.

## 2. Sensor Integration (IoT)

**Overview**  
 Environmental factors like temperature and humidity influence produce freshness. The DHT11 sensor provides this data for contextual analysis.

**Implementation**

* Sensor Data: DHT11 is used to capture temperature and humidity data in real-time.
* Microcontroller: An Arduino or Raspberry Pi collects sensor readings and transfers data to the main application via serial or wireless communication.
* Data Logging: Sensor data is displayed alongside image results for transparency and future analysis.

**Outcome** The IoT system will provide real-time ambient conditions, helping users interpret how storage environment affects freshness.

## 3. Application Interface (Streamlit)

**Overview**A simple web interface allows users to upload images and view results instantly.

**Implementation**  
- Frontend: Developed using Streamlit, offering buttons for image upload, live DHT11 readings, and display of freshness prediction.  
- Backend: Connects to the AI model and sensor API to generate and display real-time output.  
- User Experience: Designed for ease-of-use and clear visualization of results.

**Outcome**By the end of Phase 3, the Streamlit app will allow users to upload produce images, view the freshness prediction, and observe environmental data.

## 4. Data Security and Storage

**Overview**  
While the application doesn't deal with sensitive personal data, maintaining integrity of results and sensor readings is vital.

**Implementation**  
- Local Storage: Images and logs are stored locally or in a secure cloud for further analysis.  
- Access Control: Basic authentication added if deployed online to prevent misuse.

**Outcome**  
Safe handling and tracking of data inputs and results ensure reliability and reproducibility of the system.

## 5. Testing and Feedback Collection

**Overview**  
Initial system tests evaluate AI accuracy, sensor reliability, and user interface experience.

**Implementation**  
- Test Cases: Images of various fruits in different stages of freshness are used for AI model validation.  
- Sensor Calibration: DHT11 values are verified against standard thermometers and hygrometers.  
- Feedback: Early users test the system and provide insights on accuracy, ease of use, and suggestions for improvement.

**Outcome**  
Feedback is collected for Phase 4 refinements, focusing on UI enhancement, model re-training, and hardware integration improvements.

## Challenges and Solutions

**1.Image Variability**

* Challenge: Background noise and lighting conditions affect predictions.
* Solution: Apply image preprocessing, and train the model on diverse datasets

**2.** **Sensor Inaccuracy**

* Challenge: DHT11 sensors are low-cost and may have fluctuation.
* Solution: Use data smoothing and average readings over intervals.

3. **User Interpretation**

* Challenge: Users may misinterpret predictions.
* Solution: Add clear visual cues and brief explanatory text in the app.

## Outcomes of Phase 3

1. Trained and integrated AI model to detect freshness.  
2. Real-time temperature and humidity data via DHT11 sensor.  
3. Streamlit interface for user interaction.  
4. Initial feedback from real users and test datasets.  
5. Debugged and working application ready for next-phase deployment.

CODE:

