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**Completed the project named as**

**AI -Driven Smart Freshness Detector**

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Smart Freshness Detector - Phase 4 Project Report

# Phase 4: Performance of the Project

## Title: Smart Freshness Detector

## Objective:

The primary goal of Phase 4 is to enhance the performance of the Smart Freshness Detector by refining the detection model, optimizing hardware and software integration, and ensuring accurate real-time freshness assessment. This phase also includes UI enhancements and integration of sensor data for intelligent freshness predictions.

## 1. AI Model Performance Enhancement

Overview:  
The freshness prediction model has been improved using additional training data and fine-tuning techniques. The system was enhanced to better differentiate between fresh, spoiling, and spoiled produce.  
  
Performance Improvements:  
● Dataset Expansion: More image and sensor datasets were included to diversify freshness conditions.  
● Model Tuning: Decision Tree Classifier was optimized using parameter adjustments.  
  
Outcome:  
Improved accuracy in freshness classification with better handling of edge cases.

## 2. Interface and Interaction Performance Optimization

Overview:  
A simple user interface (e.g., Streamlit app) was implemented to display freshness levels based on real-time data.  
  
Key Enhancements:  
● Real-Time Visualization: Freshness prediction results are updated instantly.  
● User Feedback: Alerts for spoiling items are triggered based on thresholds.  
  
Outcome:  
The system is more user-friendly and responsive with minimal delay.

## 3. IoT Sensor Integration Performance

Overview:  
Sensors like DHT11 and color detection modules are integrated to measure real-time humidity, temperature, gas levels, color, and pH values.  
  
Key Enhancements:  
● Real-Time Sensor Data: Ensures accurate freshness prediction based on multiple variables.  
● Smooth Data Handling: Optimized to prevent latency in data retrieval.  
  
Outcome:  
The system can provide continuous and reliable freshness insights using sensor data.

## 4. Data Handling and Safety

Overview:  
Although data sensitivity is lower compared to healthcare, secure handling and validation of input data are maintained.  
  
Key Enhancements:  
● Clean Data Pipeline: Data normalization and error checks are in place.  
● Logging: Proper logs are maintained for predictions and sensor behavior.  
  
Outcome:  
Improved robustness and traceability of the system’s predictions.

## 5. Testing and Performance Metrics

Overview:  
Performance metrics were collected to ensure model readiness for larger environments.  
  
Implementation:  
● Functional Testing: All modules tested under normal and abnormal inputs.  
● Metrics: Accuracy, response time, and reliability of predictions measured.  
  
Outcome:  
The Smart Freshness Detector is ready for use with accurate, real-time freshness predictions.

## Key Challenges in Phase 4

1. Sensor Noise and Inaccuracy:  
 ● Solution: Applied averaging filters and data cleaning techniques.  
  
2. Model Overfitting:  
 ● Solution: Used cross-validation and regularization.  
  
3. Limited Image Dataset:  
 ● Solution: Augmented data with online sources and manual labeling.

## Outcomes of Phase 4

1. Accurate multi-sensor freshness detection.  
2. Real-time, user-friendly output via a visual dashboard.  
3. Reliable classification into Fresh, Slightly Spoiling, and Spoiled.  
4. Optimized and tested code for deployment.

## Sample Code

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OUTPUT