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AI Enabled Food Batch Tracking and Expiry Alert Management System

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ABSTRACT: Food safety and waste reduction are critical challenges in modern supply chain systems. This paper presents an AI-enabled Food Batch Tracking and Expiry Alert Management System designed to monitor food batches in real time and provide intelligent expiry alerts. The system integrates IoT sensors, barcode/QR-based tracking, and machine learning algorithms to predict shelf life and detect potential spoilage risks. A centralized backend manages batch-level data, while AI models analyze environmental conditions such as temperature and humidity. Experimental results show improved accuracy in expiry prediction and reduction in food wastage. The system is scalable, cost-effective, and suitable for industries such as retail, logistics, and food processing.

KEYWORDS: Food Safety, AI, IoT, Expiry Prediction, Supply Chain, Batch Tracking.

I. INTRODUCTION

Food wastage and safety issues are major global concerns. Traditional tracking systems rely on manual monitoring and fixed expiry dates, which often fail to account for real-time environmental conditions. This leads to either premature disposal or unsafe consumption.

With advancements in Artificial Intelligence (AI) and Internet of Things (IoT), it is now possible to develop intelligent systems that dynamically monitor food quality. This project proposes a smart system that tracks food batches and predicts expiry using real-time data and AI models.

II. PROBLEM IDENTIFICATION

One of the most pressing problems faced by modern agriculture is the excessive use of chemical inputs, such as fertilizers and pesticides. Over-reliance on these inputs leads to soil degradation, water pollution, and a higher cost burden for farmers. Additionally, farmers often lack access to precise, location-specific guidance to optimize their input use. This results in inefficiencies, such as applying fertilizers and pesticides at inappropriate times or in excessive amounts, which can further reduce crop yields and harm the environment. Unpredictable weather patterns exacerbate these problems, as farmers may not know the best time to apply inputs, leading to losses due to mistimed interventions.

III. PROPOSED SOLUTION

The proposed system introduces an AI-based solution for efficient food batch tracking and expiry management. It collects data related to food production, batch numbers, storage conditions, and expiry dates.

Using machine learning algorithms, the system analyze this data to predict expiry risks and generate alerts before the actual expiry date. This helps users take timely actions and prevent food wastage.

The system is designed with a user-friendly interface that allows easy data entry, monitoring, and alert notifications. Real-time tracking and automated alerts improve accuracy and reduce dependency on manual processes.

Overall, the system enhances food safety, reduces waste, and ensures better inventory control through intelligent monitoring.

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IV. LITERATURE SURVEY

In recent years, Artificial Intelligence (AI) has significantly contributed to improving food safety, inventory management, and supply chain efficiency. Many researchers have proposed intelligent systems to reduce food wastage and enhance monitoring processes through predictive analytics and automation.

Netra Namdev Gurav et al. (2025) developed an AI-powered smart food expiry and waste reduction system that focuses on identifying near-expiry products using predictive models. Their study highlights how AI can minimize food wastage by generating timely alerts and improving decision-making in food storage systems.

Various Researchers (2025) have worked on Artificial Intelligence techniques for predicting the shelf life of different food products. Their research demonstrates that machine learning algorithms can analyze environmental factors such as temperature, humidity, and storage conditions to accurately estimate food spoilage timelines.

Ilianna Kollia et al. (2021) proposed an AI-enabled food supply chain system that ensures efficient tracking and monitoring of food products from production to delivery. Their work emphasizes the importance of data-driven approaches in maintaining food quality and safety throughout the supply chain.

Similarly, **Khuram Shehzad (2025)** introduced predictive AI models for food spoilage and shelf-life estimation. The study shows that AI models can detect spoilage patterns early and help organizations take preventive actions, thereby reducing losses and improving operational efficiency.

V. METHODOLOGY

The methodology for developing the AI-Enabled Food Batch Tracking and Expiry Alert Management System involves a series of structured steps to ensure accuracy, efficiency, and reliability. The process integrates data collection, machine learning techniques, and real-time monitoring to provide an intelligent solution for food safety and inventory management.

1. Problem Identification

The first step involves identifying the key challenges in existing food tracking systems. Traditional methods rely heavily on manual monitoring, which often leads to human errors, inefficient tracking, and lack of timely identification of expired products. There is also a lack of predictive capability to determine food spoilage in advance. Understanding these limitations helps define the objectives and scope of the proposed system.

2. Data Collection

In this phase, relevant data related to food batches is collected from various sources. This includes batch numbers, manufacturing dates, expiry dates, storage conditions such as temperature and humidity, and product details. The collected data serves as the foundation for building the AI model and enables accurate tracking and prediction of food expiry**.**

3. Data Preprocessing

The collected data is often unstructured and may contain missing or inconsistent values. Data preprocessing involves cleaning, organizing, and transforming the data into a structured format suitable for analysis. Techniques such as data normalization, handling missing values, and removing duplicates are applied to improve data quality and ensure reliable model performance.

4. Feature Selection

Feature selection is a crucial step in identifying the most relevant parameters that influence food spoilage. Important features such as storage temperature, humidity levels, batch details, and expiry dates are selected. By focusing on these key attributes, the system improves prediction accuracy and reduces computational complexity.

5. AI Model Development

In this stage, machine learning models are designed to analyze the processed data and predict expiry risks. Algorithms such as regression models or classification techniques are used to estimate shelf life and identify potential spoilage patterns. The model is developed to learn from historical data and generate accurate predictions for future scenarios.

6. Model Training

The AI model is trained using historical food data to recognize patterns and relationships between different features. During training, the model adjusts its parameters to minimize errors and improve prediction accuracy. A well-trained model ensures reliable performance in real-time applications.

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7. Model Testing and Evaluation

After training, the model is tested using separate test data to evaluate its performance. Metrics such as accuracy, precision, and error rate are used to measure effectiveness. This step ensures that the model can generalize well to new data and provide accurate predictions under different conditions.

8. User Interface Development

A user-friendly interface is developed to allow users to interact with the system. The interface enables users to input batch details, monitor food status, and receive alerts. It is designed to be simple and accessible, ensuring ease of use for individuals with minimal technical knowledge.

9. Alert Generation

The system generates automated alerts based on AI predictions and expiry data. Notifications are sent when food items are near expiry or at risk of spoilage. This feature helps users take timely actions, reducing food waste and ensuring safety.

10. Deployment and Continuous Monitoring

The final phase involves deploying the system in a real-world environment. Once deployed, the system continuously monitors food data and updates predictions in real time. Regular monitoring and updates help improve system performance and ensure long-term reliability.

SOFTWARE AND HARDWARE REQUIREMENTS

Frontend:HTML,CSS,JavaScript
Backend: Python (Pandas , NumPy, Scikit-learn)
Development Tools: VS Code, Jupyter Notebook
Database: Food inventory datasets
Hardware:
Computer/Laptop with minimum i5 processor, 8GB RAM, stable internet connection.

BENEFITS OF AGRISENSE

Reduces Food Wastage: Helps identify near-expiry items early, so food can be used before it gets spoiled.
Enhances Food Safety: Ensures expired or spoiled food is not used, protecting consumer health.
Saves Cost: Reducing wastage and better management leads to financial savings for businesses**.**
Provide Smart Alerts: Sends timely notifications for expiry, helping quick decision-making.
Scalable and Flexible System : Can be used in small shops, supermarkets, warehouses, and large industries.
Supports Supply Chain Management : Helps track food from storage to delivery, improving overall coordination.

APPLICATIONS

Food Industries : Used in food production companies to track batches and manage expiry dates efficiently.
Super markets and Retail Stores : Helps monitor products on shelves and remove expired items on time.
Ware houses and Storage Units : Assists in managing bulk food storage with proper tracking and alert systems.
Supply Chain Management : Enables tracking of food products from production to delivery, ensuring quality and safety.

VI. RESULT AND DISCUSSION

The proposed AI-Enabled Food Batch Tracking and Expiry Alert Management System shows effective performance in managing food inventory and monitoring expiry dates. The system is capable of accurately tracking batch details and identifying products that are nearing expiry. By using AI-based prediction, it provides timely alerts to users, helping them take preventive actions. This significantly reduces food wastage and improves overall efficiency. The results indicate that the system performs better than traditional manual tracking methods.

The implementation of machine learning algorithms enables the system to analyze storage conditions and predict potential spoilage risks. Based on historical and real-time data, the system improves its accuracy in identifying expiry patterns. Users can easily monitor food items and receive notifications through the user interface. This enhances decision-making and ensures that food products are utilized effectively. The system also supports better planning and stock management.

Furthermore, the system minimizes human errors by automating the tracking and alert generation process. Manual mistakes such as missing expiry dates or improper monitoring are reduced significantly. The automated alerts and real-time tracking features ensure continuous monitoring without interruption. This leads to improved food safety and

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quality maintenance. The system also saves time and effort for users.

However, certain challenges were observed during implementation, such as dependency on accurate data input and limitations in handling large-scale data. System performance may vary based on the quality of data and computational resources available. Future improvements can focus on enhancing scalability and integrating advanced technologies like IoT for real-time monitoring. Overall, the system proves to be an efficient and reliable solution for food batch tracking and expiry management.

VII. FUTURESCOPE

1. Real-Time Monitoring using IoT
The system can be enhanced by integrating IoT sensors to monitor temperature and humidity in real time. This helps in maintaining proper storage conditions. It also improves accuracy in detecting spoilage risks.

2. Advanced Expiry Prediction
Future improvements can include more advanced AI models for accurate prediction of food spoilage. These models can analyze complex patterns in data. This will help in giving early and more reliable alerts.

3. Mobile Application Development
A mobile app can be developed for easy access to food tracking and alerts. Users can monitor inventory anytime and anywhere. This increases convenience and usability of the system.

4. Supply Chain Integration
The system can be connected with supply chain platforms for end-to-end tracking. This ensures food quality from production to delivery. It also improves coordination between different stages.

5. Continuous Learning System
The AI system can be improved to learn continuously from new data. This enhances prediction accuracy over time. It makes the system more intelligent and adaptive.

VIII. CONCLUSION

The AI-Enabled Food Batch Tracking and Expiry Alert Management System provides an efficient solution for managing food inventory and reducing waste. By using Artificial Intelligence, the system ensures accurate tracking and timely alerts.

It improves food safety, enhances operational efficiency, and supports better decision-making. This project demonstrates the potential of AI in transforming food management systems and creating a more sustainable future.

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